DISEASES OF WOMEN

PITUITARY GLAND
Posterior lobe   Anterior lobe

FOLLICLE RIPENING HORMONE   LUTEINIZING HORMONE

Surface views of developing follicle   Surface views of developing corpus luteum

Sections of developing follicle   Sections of developing corpus luteum

Maturing follicle   Ovulation   Early   Mature   Fading

ESTROGEN PREDOMINANT   PROGESTIN PREDOMINANT

Cervix   Cervix

Menstrual and
early growth   Late growth   Early secretory   Late secretory
and menstrual

SECTIONS OF ENDOMETRIUM AT DIFFERENT STAGES OF CYCLE

Estrogen
(Blood)
Progestin (Probable)

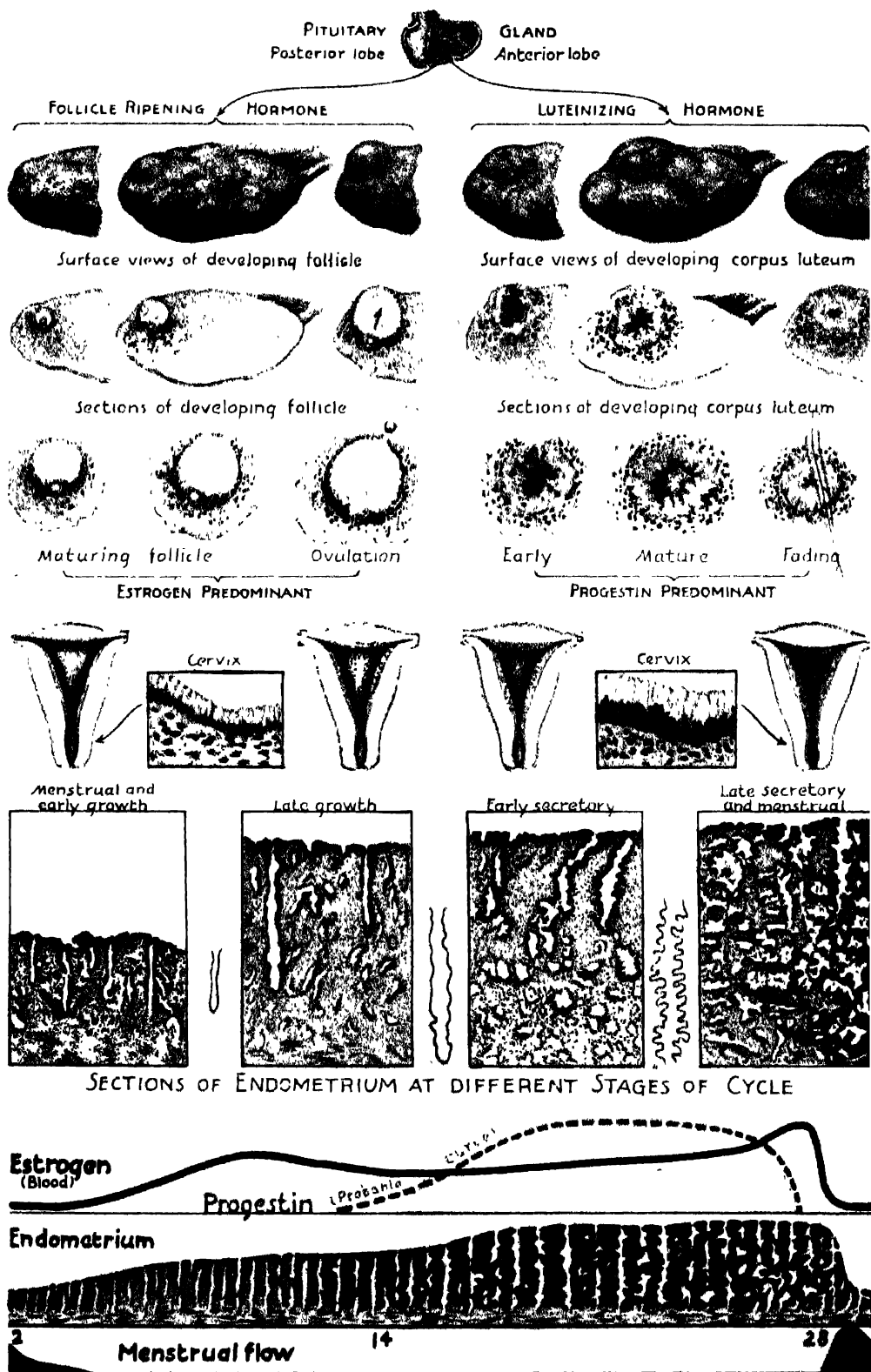Endometrium

2   14   28

Menstrual flow

FIG. 1.—THE PITUITARY-OVARIAN-UTERINE CYCLE.

DISEASES OF WOMEN

BY

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Gynecology

NINTH EDITION, ENTIRELY REVISED AND RESET

(Reprinted With Additional Text and Illustrations)

WITH ELEVEN HUNDRED THIRTY-FIVE ENGRAVINGS
INCLUDING FIFTY-THREE IN COLOR

ST. LOUIS
THE C. V. MOSBY COMPANY
1922

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TO THE MEMORY OF

DR. HENRY HODGEN MUDD

THIS WORK IS RESPECTFULLY

DEDICATED

AS A TOKEN OF APPRECIATION

OF

HIS SPLENDID PROFESSIONAL ATTAINMENTS,

HIS UNSELFISH DEVOTION TO THE CAUSE OF MEDICAL EDUCATION

AND HIS INSPIRING PERSONAL FRIENDSHIP

PREFACE TO NINTH EDITION

The signal advance in recent years in gynecologic diagnosis and treatment has come largely through intensive study of physiology. In accordance with this fact and to emphasize the growing importance of such study for the understanding and successful treatment of pelvic disorders, a physiologic subject has been chosen for the frontispiece place of honor. It stands at the beginning, to indicate to those who would enter this field of knowledge that they must immediately tackle the intricate problems of the how and why of functional phenomena.

The necessity for such study applies not only to hormones and endocrine activities, now holding the center of the stage, but to every factor which enters into the transformation of intake, through all avenues, to the output of the organs in normal products and in pathological pains and dysfunction. The areas where obvious anatomy disappears into the invisible processes of function constitute the frontiers of knowledge, where pioneers delve and struggle and gradually advance into the unknown. Here, the blood with its many activities, the nerves with their sympathetic and parasympathetic impulses, the muscle cells which change food into power, and the hormones and vitamins with their chemical and physical and vital reactions, all work together to bring about those wonderful transformations, concerning which we have learned so much and yet, on the whole, know so little.

This physiological trend has shifted major investigative interest in anatomy from the gross structures, which in the main are well known, to the minute structural details which mold function in the special cell areas of each organ. For example, in the myometrium and endometrium there are types of terminal apparatus by which ordinary nerve control of vasomotor and other activities combines with local hormone control to cause the normal menstrual disintegration and exfoliation of the endometrium.

Diagnosis and treatment have advanced with this increase in knowledge of physiological and pathological activities. Care has been taken to present these advances in a practical way so that, in the daily handling of patients, they may be used effectively and with understanding of the principles on which they rest.

The endeavor has been to present for the student the basic facts and salient developments of the biologic and physiologic investigations which are making history in the gynecologic field, and to bring to the practitioner a comprehensive systematic judicial consideration of the diagnostic and therapeutic helps made possible by these great advances in knowledge. The accomplishment of this difficult task has been greatly facilitated by the kind permission of authoritative workers for the use of their helpful illustrations. The cordial cooperation of these busy investigators and of the publishers of their books and articles has given stimulation and pleasure to the task.

The corpus luteum and its hormonal influences constitute a feature of growing importance. We appreciate particularly the help given by Dr. Willard M. Allen who kindly consented to check over the data concerning the corpus

luteum and its hormones, on which he has carried out such extensive and authoritative work, and also concerning other points in the great field of ovarian and uterine physiology. His kindness in criticizing does not commit him to specific statements, for the advance is so rapid that modifying information is developed from day to day.

To bring the essential features of expanding gynecologic knowledge within the limits of a textbook has required much sifting and condensation of both old and new text. Along with the large amount of new text, there have been added also one hundred and forty-five new illustrations, many of them in color.

In this connection, we wish to express appreciation of the work of Mr. Ivan F. Summers, who combines with his artistic technique and anatomical knowledge a most helpful interest and ability in devising ways of translating ideas into visual symbols.

THE AUTHORS.

PREFACE ITEMS FROM PREVIOUS EDITIONS

Space is very limited, but it is well to mention some of the preface items of previous editions. The active life of this work so far covers a period of more than thirty years, the first edition appearing in 1907. It was begun and has continued as a presentation of the fundamentals of gynecology unencumbered by the space-devouring details of major operative technique, which details were presented in another work.

The primary endeavor, stated in the first preface, was to present the important points *clearly and systematically*—so clearly and so systematically that they will be readily understood and well retained in mind for use at the bedside. To this end much thought has been given to the *arrangement of the text,* so as to show not only the facts of a subject, but also the mutual relation of the facts and their bearing and relative importance in the diagnosis and treatment.

To this end illustrations were freely used. To the more than two hundred original drawings and photographs for the first edition were added many illustrations from gynecologic literature, the endeavor being to bring the best illustration available to elucidate each point. This policy has been continued, and I wish here to express again my appreciation to the authors and publishers through whose kindness I am able to use these instructive illustrations.

It is interesting to note, in the preface items of the editions, the succession of gynecological subjects as they came to study and elucidation by gynecologists —pelvic inflammation, tubal pregnancy, the application of serologic studies to gynecology, cell studies in regard to cancer, the x-ray visualization of the uterine and tubal cavities, the ductless glands, and later the great enlightenment of the ovarian-pituitary cycle and other endocrine connections.

The various physicians and artists who have assisted in different editions have been mentioned with appreciation in those editions. Dr. Hugo Ehrenfest gave signal help not only in completing the fourth edition when I was called to duty with our troops in France in World War I, but also in furnishing a

most instructive chapter on the endocrine glands running through several editions. Later, this subject expanded so much that it was necessary to distribute to each chapter the portion relating to the organ there considered.

In the eighth edition, the great expansion in detailed pathology and hormonal physiology and diagnosis and treatment was due to the activity of the coauthor, Dr. Robert J. Crossen, who was indefatigable in search and analysis and in efforts at practical presentation of the application of the newer knowledge to the various problems encountered in gynecologic work.

The publishers have aided and encouraged throughout by their courtesy and cordial cooperation.

H. S. CROSSEN.

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DISEASES OF WOMEN

DISEASES OF WOMEN

CHAPTER I

ANATOMY AND PHYSIOLOGY

of the Genital Tract

The genital tract in the female is a constantly changing structure, from the time it starts to develop until its functions end. This fact is emphasized in Fig. 1 (colored Frontispiece), and it must be kept in mind in all considerations of anatomy, physiology, and pathology. We must remember not only the striking normal changes which take place every few weeks in connection with ovulation and the still greater changes due to pregnancy, but also the structural changes during development to the point of function and during subsidence after the menopause.

This constant change creates a problem in anatomical description. Ordinarily we visualize anatomical structure as a stable and relatively fixed factor in the body. Thus it becomes an island of dependability in the fluctuating sea of physiological actions and reactions. But here our island of dependability shifts from week to week, with resulting confusion as to the boundries between anatomical structure, physiological change, and pathological development. Witness the difficulties of uterine specimen interpretation in the laboratory, some of which difficulties baffle even the specially trained and experienced gynecological pathologist. A practical approach, however, to the problem of describing the anatomy is to divide the structural features of each organ into those which are relatively constant throughout the childbearing period and those which change with functional activity. The first may be considered as the anatomy of the organ and the second as part of the physiology.

The essential pelvic organs in the group of structures involved in gynecologic* diseases are shown in Figs. 2 to 6. They are as follows:

1. The **ovaries,** in which the ova are formed.
2. The **fallopian tubes,** which conduct the ova from the ovaries to the uterus.
3. The **uterus,** which receives and nourishes the fertilized ovum and expels the fetus at term.
4. The **vagina,** which is the connecting link between the uterus and the outside world.

There are also several accessory structures: namely, the external genitals, the perineum, the pelvic floor, the pelvic connective tissue, and the pelvic

---

*As to the pronunciation of "gynecology," the weight of authority is decidedly in favor of soft g, short y and the accent on the third syllable—jin e kol' o je (Webster's Unabridged Dictionary, Century Dictionary, Standard Dictionary, and the following medical dictionaries— Gould's, Keating's, Dorland's). A few authorities differ, some favoring soft g and long y, and others favoring hard g and long y.

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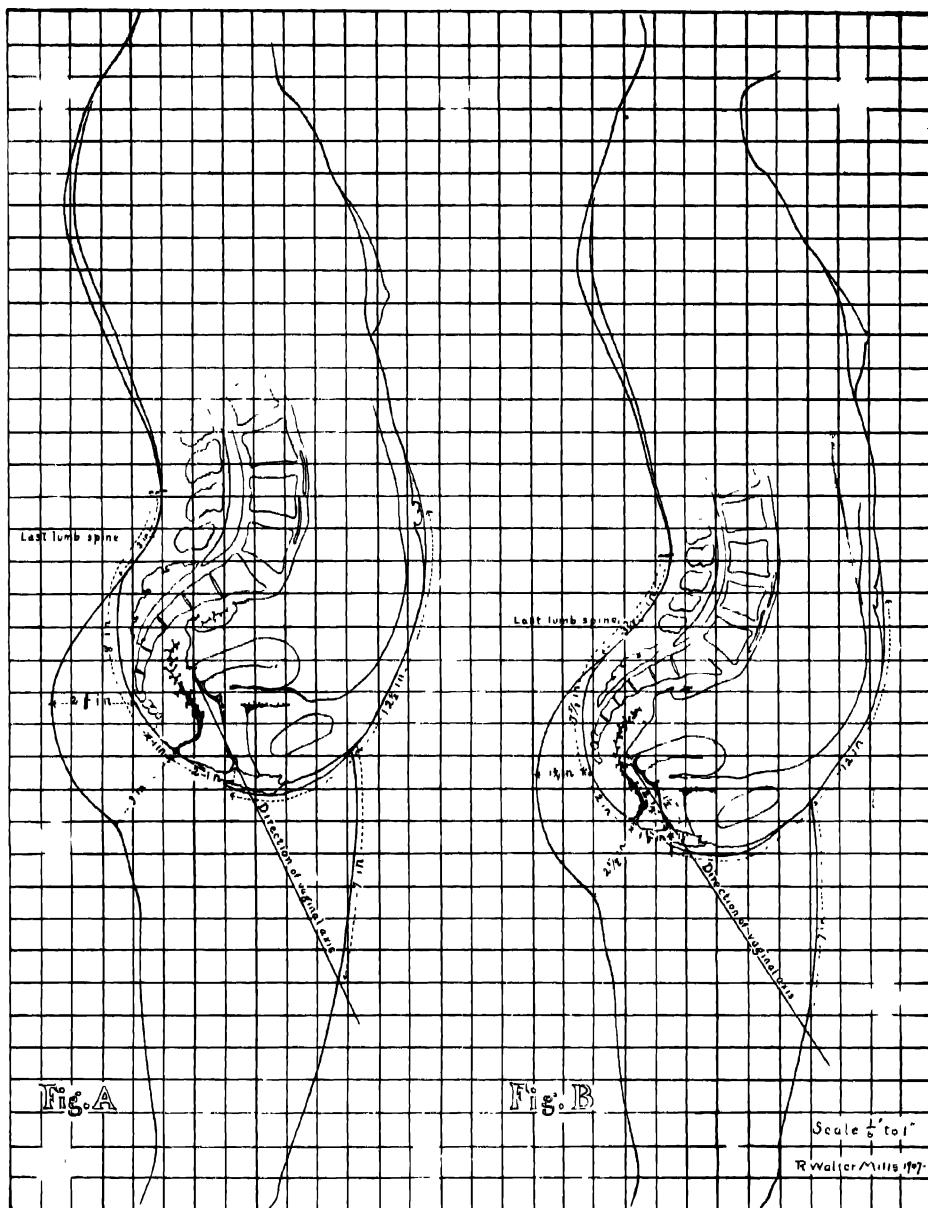
Fig. 2.—*A*. Exact contour and measurements of the woman selected for Fig. 3. *B*. Exact contour and measurements of another model, presenting a more pronounced lumbar and abdominal curve. The small squares represent one-inch squares at life size. (R. Walter Mills.)

A. Artist's model, aged twenty-eight years, mother of two children (six and eight years old respectively), has worn corset practically none, is in good health and fairly muscular. Height 5 ft. 7 in., weight 140 lb., bust measure 36 in., waist 27 in. (2 in. above umbilicus), circumference at umbilicus 30 in., hips 39 in., thigh 22½ in. (2 in. below gluteal crease), anteroposterior diameter of body at waist 6¾ in., anteroposterior diameter of thigh (2 in. below gluteal crease) 6⅝ in. The other data are given on the outline. To conform to the so-called "perfect form" the hips should be a trifle larger and the weight somewhat more.

B. Young woman, aged twenty-seven years, never pregnant, has worn corset very little, is in good health and muscular. Height 5 ft. 4 in., weight 114 lb., bust measure 32 in., waist 24 in. (2 in. above umbilicus), hips 38 in., thigh 22 in. (2 in. below gluteal crease), anteroposterior diameter of body at waist 6½ in., anteroposterior diameter of thigh (2 in. below gluteal crease) 6⅝ in. The other data are given on the outline. The lumbar and abdominal curves are more pronounced than in *A*.

The numerous exact measurements here given constitute valuable data to guide in medical drawings of this character.

FIG. 3.—ANTEROPOSTERIOR SECTION OF PELVIS (SEMIDIAGRAMMATIC).

In order to show the structures and relations exactly as they are in what may be considered a typical woman in the erect posture, a detailed study was made of many drawings from frozen sections for the internal relations, and of several well-formed women in the normal standing posture for the contour and external relations. This gave a result differing considerably from the usual representation of a patient standing, made by taking a drawing of a section of a flattened cadaver and turning it upright. The lumbar curve is more marked, the lower abdominal wall and the buttocks are more prominent and there is a change of the relations of the internal organs to the external landmarks.

For the internal relations the admirable frozen sections of Sellheim were principally followed, and the exactness with which the pelvis and contents of the actual sections fitted into the contours of the living models was most pleasing and instructive. (Redrawn and colored from original drawing by Dr. R. Walter Mills.)

peritoneum. In addition, there are certain distant structures connected with the endocrine system which have a special and marked influence on the pelvic organs. These will be mentioned in their proper connections.

Before describing the anatomy and physiology of the individual organs, it is well to call attention to certain general features. The situation of these organs in the bony pelvis gives them excellent protection from accidental injury. Even in crushing injuries, which have increased so much with the extended use of the automobile and airplane, this strong protecting box of bone usually prevents serious damage to the contained organs.

This rigid framework of the pelvis, through which the child must pass in labor, requires special study and detailed measurements in obstetrics, but for gynecologic work general consideration will suffice. The pelvis is formed by four bones: the two hipbones, the sacrum, and the coccyx. Each hipbone (os innominatum) consists of three parts: the ilium, ischium, and pubis. These are separate bones in early life, but there is gradual ossification of the cartilaginous junctions so that by the twentieth year the three parts are fused, forming the remarkable os innominatum, which bears the weight of the body and furnishes specially-shaped surfaces for the attachment of the complicated muscular mechanism which operates the lower extremity. In early life these functions of weight-bearing and muscular activity put strain on the extensive cartilaginous parts, hence the importance of maintaining the nutritional integrity of cartilage in early years in order to avoid the pelvic deformities which are so serious in childbearing.

It is well to call attention to the fact that the anatomical "perineum" includes all the area of the pelvic outlet, extending medially from the pubic arch to the coccyx and laterally to the ischial tuberosity of each side. The wedge of soft tissues lying between the rectum and vagina at their lower ends is the "perineal body." In gynecological writings, however, the perineal body is usually referred to as the "perineum," that being a shorter and more convenient term, to which long usage has given a specific meaning in connection with the soft tissues closing the pelvic outlet in the female.

The female generative organs are located in intimate contact with the bladder and rectum. Consequently bladder and rectal diseases are often mistaken for disease of the genital tract, and vice versa. This fact must be kept in mind, particularly in obscure or chronic disturbances, and special examinations resorted to as necessary to insure differentiation.

The bladder and rectum fill and empty (become larger and smaller) at irregular intervals. This calls for considerable mobility of the uterus which lies between them. This mobility is attained and properly limited by a mechanism involving several factors, the particulars of which we shall study later when dealing with uterine displacements.

In this first chapter will be given the anatomy and physiology of the adult organs, together with the maturing to function and the changes of subsiding function. Development of the genital tract is most usefully considered in connection with developmental anomalies, and hence is given in the chapter on Malformations (Chapter XIII). The anatomy and physiology (supporting
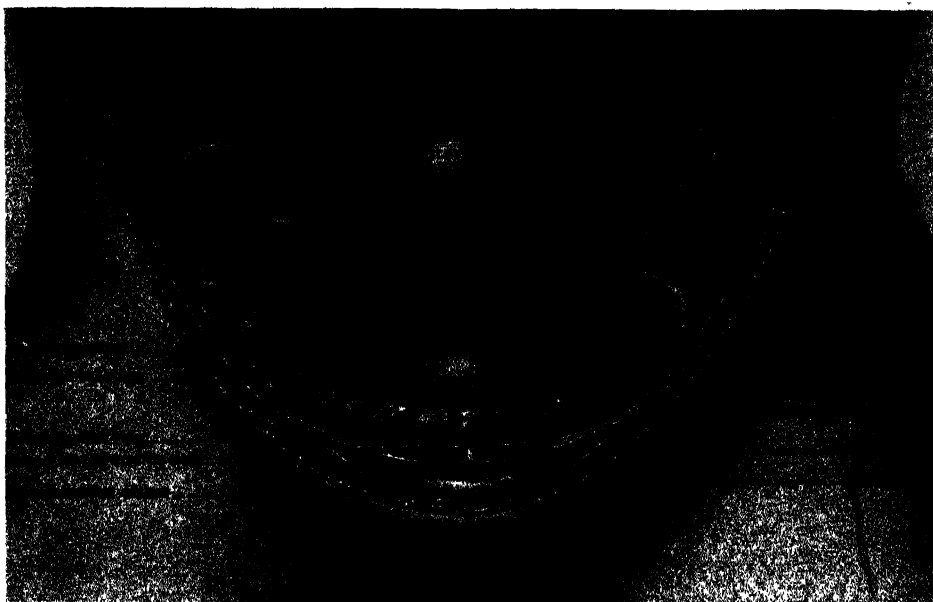
Fig. 4.—View of pelvic organs from in front, showing the relations of various structures to each other and to the abdominal wall.
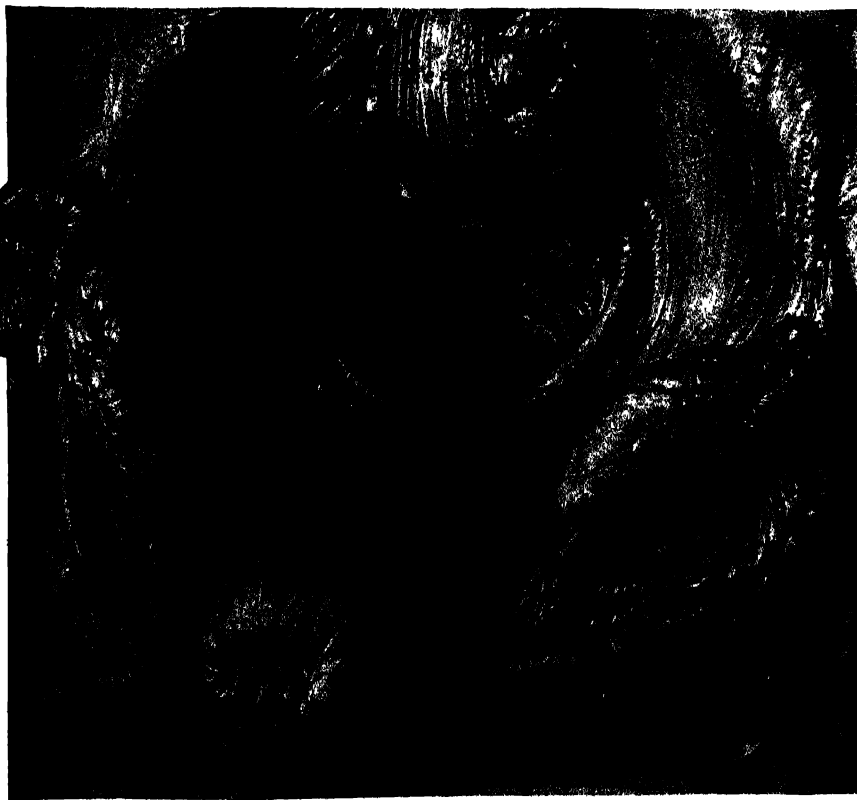
Fig. 5.—View of the pelvic structures back of the uterus and broad ligaments. (Kelly—*Gynecology*, D. Appleton-Century Company.)

Fig. 6.—View from behind, showing on the left the relations of ovary and fallopian tube and posterior surface of uterus. On the right is a section of the uterus, tube, ovary, and broad ligament, showing the relations of these various structures and their blood supply.

The sectioned ovary shows its connection with the broad ligament at the hilum, where the blood vessels and lymphatics and nerves enter. The utero-ovarian vascular arc gives free blood supply to the ovary, tube, and uterus. The ureter, on its way from the bladder to the kidney, is cut across just posterior to the uterine vessels under which it passes in the broad ligament. Notice the gradual but marked enlargement of the tubal cavity from the very narrow uterine portion to the outer portion (ampulla).

action) of the pelvic floor are best discussed in connection with relaxation and other damage to those structures and will be found in Chapter V.

In taking up the anatomy and physiology of the pelvic organs we begin with the most important, namely, the ovary. All other parts of the genital tract are dependent on the ovary for their structural development and physiologic activity. The structure and physiology of the ovary must be known before there can be an understanding of the physiologic changes in the other organs, for example, in the uterus or the tubes or the vaginal mucosa. Therefore the *order* of consideration in this chapter will be: ovaries, uterus, tubes, pelvic peritoneum, pelvic connective tissue, vagina, and external genitals.

OVARY

The ovary is a temporary organ with an active life span of about thirty-five years. It is a remarkable organ in that its product is not simply some special secretion, to complement the many other secretions in rounding out the physiology of daily activities, but a special cell for originating another individual. This special cell carries the spark of a separate life, and also within its small compass there exists something which later flowers into the characteristics of the donor and of her ancestors for generations back. In addition to producing this potent cell, the ovary controls the development and functioning of the organs which receive and nourish the fertilized ovum and expel the separate individual at the proper stage of development. With these important and mysterious functions, it is little wonder that there are two ovaries, to double safeguard this heritage, and that the more we learn about ovarian physiology the wider become the dim horizons of the unknown.

Structure.—The human ovary is approximately one and a half inches long by one inch wide and half an inch thick, though the ovaries vary much in size in different persons and even in the same individual the two ovaries may differ considerably. The ovaries are situated one on each side of the uterus near the pelvic brim and close to the outer end of the fallopian tube (Fig. 6). Each ovary projects from the posterior wall of the broad ligament of its respective side, as shown in Fig. 7, and the peritoneal fold thus formed is called the "mesovarium." It is through this attachment to the broad ligament that the ovary receives its blood supply. The area where the vessels and nerves find entrance and exit is called the hilum of the ovary (Fig. 8). Immediately about the hilum, and extending some little distance into the ovary, is the area known as the medulla or **medullary portion.** This is occupied by the blood vessels, lymph vessels, the nerves, and supporting connective tissue. It contains no follicles, but it contains remnants of the tubular structure which in the male develops into the testicle.

The remaining part of the ovary contains the graafian follicles, and is called the cortex or **cortical portion** (Fig. 8). The free surface of the cortical portion—that is, the peritoneal surface of the ovary—is covered with cylindrical epithelium, the remains of the germinal epithelium from which ova and graafian follicles were formed by infoldings. It is supposed that ova and graafian follicles are formed also from the ovarian mesenchyme in the substance of the ovary, as mentioned later.

In structure the ovary is simply a collection of ova, or microscopic eggs, supported and held together by the connective tissue which forms the framework. Each ovum is contained within a minute sac called the ovisac or graafian follicle, and a section of an ovary shows graafian follicles in various stages of development. This characteristic structure of the human ovary is shown diagrammatically in Fig. 8.

The connective tissue extends between the follicles in all directions and, in addition to supporting and protecting them, carries the blood vessels which nourish them and also the lymph vessels and nerves. This connective tissue constitutes the ovarian stroma, or interstitial tissue, and is peculiar in that it is exceedingly rich in cells, which are packed so closely together that in an ordinary microscopic preparation the tissue seems to consist nearly altogether of dark-staining nuclei. Near the periphery of the ovary the connective tissue fibers become more numerous and the nuclei fewer, so that there is here a rather dense capsule. This fibrous capsule of the ovary is known as the "tunica albuginea." It is simply a condensation of the ovarian stroma and serves to protect the deeper structures. Outside of this fibrous layer lies the epithelial covering already mentioned.

The **graafian follicles** are very numerous and of different sizes, as shown in Figs. 9 and 10. The small young follicles (primordial follicles) lie near the surface and number thousands. The great number and crowded condition in the outer portion of the growing ovary are well shown in Fig. 10. As the follicle develops, the single layer of cells lining it proliferates and the lining becomes many-layered, as in the follicle at the bottom in Fig. 10.

The follicles formed from the germinal epithelium on the surface of the ovary are very small at first but as they grow down they increase in size. When they are of medium size the direction of growth is reversed and with further enlargement they approach the surface. The pointed "theca cone" is an interesting factor in this movement toward the surface by the maturing follicle, as explained later under ovulation. Many eggs develop that one may ovulate. The less-favored (or supporting) ova secrete estrogen which aids progesterone in causing the progestational changes. These less-favored ova die and their follicles become atretic.

The graafian follicle is lined with an epithelial layer several cells thick, called the "membrana granulosa," and is filled with clear viscid fluid, the "liquor folliculi." The **ovum** lies within the follicle near one side and is completely surrounded by cells of the membrana granulosa.

As the graafian follicle matures, it approaches the surface and becomes still larger. It gradually protrudes at the free surface of the ovary, and when ripe it bursts, liberating the ovum on the surface of the ovary, from where it finds its way into the fallopian tube. This ripening and bursting of the graafian follicle and liberation of the contained ovum constitutes **ovulation**, which is considered in detail under the physiology of the ovary.

New generations of eggs are continuously becoming differentiated from indifferent cells throughout sexual maturity, hence the life span of an ovum is probably very short. With the death of the ovum the granulosa cells die and disappear. Such a degenerated atretic follicle is small, and it eventually

atrophies and is obliterated through a deposit of new connective tissue elements. In some, however, the fluid increases after the ovum dies, thus forming a minute cyst. If there are many of these small follicular cysts, the condition is designated "cystic ovary." Occasionally one or more will become larger through a pathological accumulation of follicular fluid, and may become important clinically.

Edgar Allen gives this brief concept of ovarian physiology: "Since the blood stream is the common carrier for both nutritional and hormonal supplies, the matter of competition for limited quantities of these substances, amounting actually to a struggle for survival in some instances, seems most fundamental in any concept of ovarian physiology. The developing eggs in the mammalian
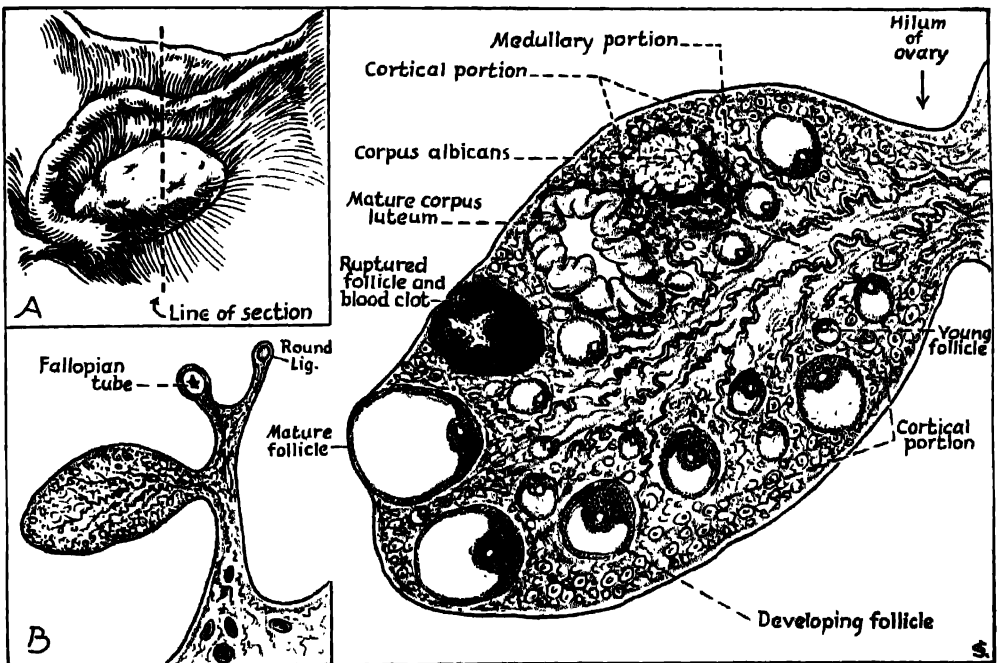
Fig. 7.   Fig. 8.

Fig. 7.—Ovarian structures and relations. *A*, Showing surface relations of ovary, tube, and round ligament, and the line of section for *B*. *B*, Showing the attachment of the ovary to the broad ligament at the hilum, and incidentally the relative locations of the tube and round ligament.

Fig. 8.—Diagrammatic representation of the details of ovarian structure. The blood vessels, lymphatics, and nerves enter at the hilum and, with their connective tissue supports, extend through the center of the ovary, forming the medullary portion. From this central location nutrition and drainage and nerve control are supplied to the cortical portion, which is the special functioning part of the ovary.

ovary might truly be considered a crowded population in a life and death struggle for limited amounts of vital necessities, a struggle so severe that only 400 human eggs, of hundreds of thousands, may reach maturity and be ovulated during the reproductive life of the average woman."

After the ripened ovum is discharged, the ruptured follicle fills with serum which clots, and the rent in the follicular wall soon heals. In a few days pigment appears in certain cells about the periphery. These cells increase rapidly in size and form a thick wavy wall in the outer portion of the broken follicle.
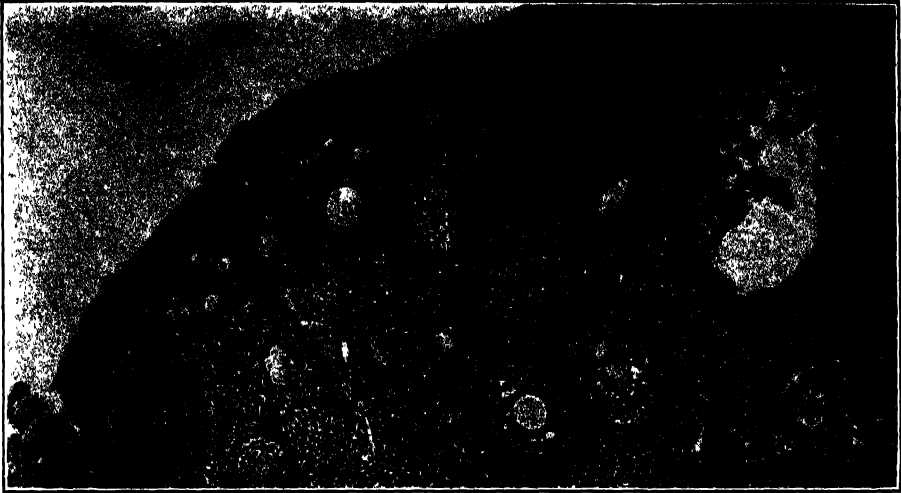
Fig. 9 —Photomicrograph of ovary of rabbit, showing follicles in various stages of development. Notice the primordial follicles in the cortex and the developing follicles in the deeper portion of the ovary. Gyn. Lab.

Fig. 10.—Photomicrograph of the cortical portion of ovary of a two-year-old child. Notice the large number of primordial follicles, embedded in a stroma which is characteristically ovarian. Note the large developing follicles in the deeper portion of the section. Gyn. Lab.

Since the pigment in the cells is yellow, the cells are called "lutein" cells, and the mass formed by them is, of course, also yellow and hence is called the **corpus luteum** (yellow body). A section of a corpus luteum shows this wavy yellow outer portion formed by the lutein cells (Fig. 11). Under high power the secreting cells are seen in typical gland formation (Fig. 12).

The recent corpus luteum is a prominent structure in the ovary, as shown in **Fig. 13.** On account of its size and vascularity and hemorrhagic appearance it may be mistaken for a hemorrhagic cyst of the ovary. Such normal corpora lutea constitute some of the so-called "blood cysts" removed by operators not familiar with pelvic physiology. The various changes in the corpus luteum are described and illustrated in detail under Physiology of the Ovary.
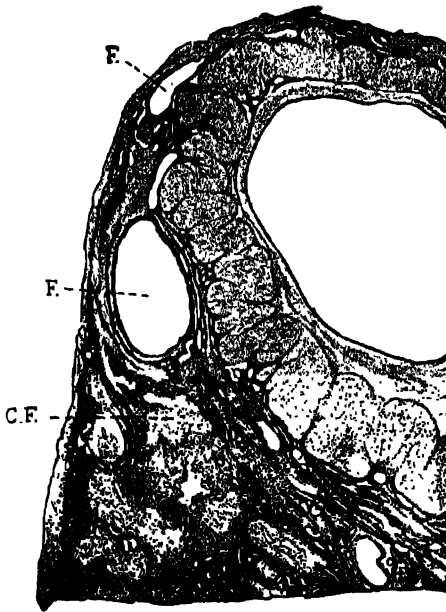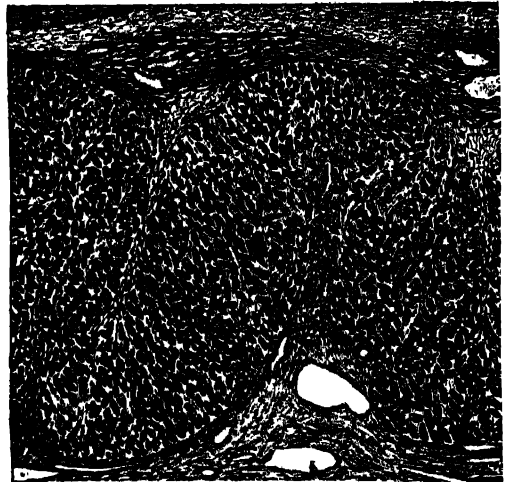
Fig. 11.   Fig. 12.

Figs. 11 and 12.—Corpus luteum. Fig. 11, Section through a corpus luteum, low power, showing the distribution of the layer of luteum cells, as a wavy wall about the cavity. Fig. 12, High power of the luteum layer, showing details of the cells. (Williams—*Obstetrics*, D. Appleton-Century Company.)

The lutein cells gradually disappear, and after a time the area of the ruptured follicle is occupied only by hyaline material and scar tissue. The area is then no longer yellow, but white, and consequently is called the **corpus albicans** (white body, Fig. 8). The corpus albicans represents the final stage of the ruptured follicle. After many follicles have ruptured, the surface of the ovary often becomes very uneven on account of the number of these depressed scars (Figs. 5 and 7, *A*).

Ordinarily the corpus luteum passes through the described changes in a short time. If, however, pregnancy follows ovulation, the corpus luteum of that ovulation grows very large and remains for months before retrograde changes set in.

The senile ovary is made up largely of old corpora lutea with resulting hyaline areas (Fig. 14). The follicles disappear and the stroma becomes more or less fibrous (Fig. 15).

In the histologic study of the ovary, certain remnants are found which do not conform to the characteristics of the ordinary elements. These consist of invaginations or islands of germinal epithelium which have some of the

A.   B.

Fig. 13.—*A*, Ovary with recent corpus luteum at left end. *B*, Ovary sectioned showing what a prominent structure the recent corpus luteum is in the ovary. Gyn. Lab.
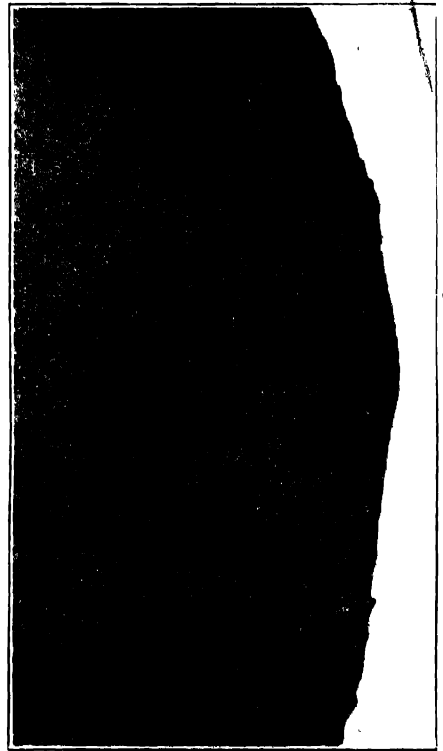
Fig. 14.   Fig. 15.

Figs. 14 and 15.—Senile ovary. Fig. 14, Section of the entire ovary. Notice the masses of hyaline material, due to merged corpora albicantia, and also the thickened vessel walls. Fig. 15, High power photomicrograph from the margin. Notice the entire absence of follicles and the change in the stroma, so that it resembles fibrous tissue. Gyn. Lab.

characteristics of the epithelium of other localities, for example, tubal or endometrial. Such a remnant of erratic development (embryological "rest") may remain simply as a part of the histologic picture of that ovary or it may develop into a definite pathological structure, e.g., a serous cyst or pseudomuci-

nous cyst or endometrial cyst or granulosa-cell tumor or even a tumor of male sexual cells (arrhenoblastoma).

Ligaments.—The ovary lies in the pelvis obliquely and its inner end is about one inch from the uterus. Extending from this end of the ovary to the uterus is a small fibromuscular cord, the "utero-ovarian ligament," which joins the uterus just below the fallopian tube. . The suspensory ligament of the ovary, the "ligamentum suspensorium ovarii," is the thickened edge of the broad ligament connecting the ovary and tube with the side of the pelvis. The "infundibulo-ovarian ligament" extends from the ovary to the outer end of the fallopian tube, and usually carries an elongated fimbria.

Vessels and Nerves.—The ovary is supplied with blood by several branches of the ovarian artery, which corresponds to the spermatic artery in the male. The ovarian artery arises directly from the abdominal aorta and, passing downward to the side of the pelvis, enters the broad ligament and sends branches to the ovary and uterus and tube. The terminal portion of the uterine artery connects with the ovarian, thus forming an arterial arch which supplies the ovary and tube, and this uterine portion is sometimes of major importance. Consequently, in salpingectomy with preservation of the ovary, care must be taken to avoid occluding this arch in order to maintain good blood supply to the preserved ovary. This arterial arch is shown fairly well in Fig. 6. The venous supply of the ovary corresponds to the arterial supply. They form a plexus in the broad ligament near the hilum of the ovary which is known as the pampiniform plexus or the ovarian plexus.

The lymphatic spaces surround the graafian follicles and ramify throughout the connective tissue of the ovary. They pass out at the hilum and anastomose with the uterine lymphatics in the broad ligament and empty into the lumbar glands. The distribution of the lymphatic vessels and glands is shown in Fig. 67 along with the uterine lymphatics.

The nerves come from the renal and spermatic ganglia of the autonomic nervous system, and entering the hilum they ramify throughout the ovary. As with the blood vessels and the lymphatics, the nerve supply of the pelvis including the ovary is best taken up for illustration as a unit, and these general illustrations accompany the discussion of the uterus (Figs. 68 to 73).

PHYSIOLOGY
of Ovary

The ovary has two functions. One is the formation and discharge of ova, which are the essential female reproductive cells, and the other is the endocrine function. The two functions are intimately connected, each being dependent on the other.

OVULATION

Ovulation is the term applied to the maturing and discharge of an ovum. The progressive stages in ovulation, together with associated changes in the uterus and in hormonal levels, are shown in Fig. 1 (colored Frontispiece). The three steps, follicle formation and maturation and rupture with discharge of ovum, are indicated diagrammatically in Figs. 16, 17, and 18.

In man the future primordial cells which are to form the gonad become differentiated early in embryonal life. These large cells finally lodge in the region of the future gonad. As embryonic development progresses, there are periods in which these so-called primordial germ cells, which are now in the overlying germinal epithelium of the gonad, invade the underlying ovarian mesenchyme. The first period of invasion occurs before sex differentiation is evident. During this period tubules are formed by the epithelial downgrowths. If the gonad subsequently becomes an ovary, they remain in the medulla of the ovary as the medullary tubules. If a testicle is formed, they become the seminiferous tubules containing sex cells. With the next period of invasion into the ovary, according to the theory of Waldeyer, of Felix, and of Winivarter, ova and follicles are formed from ingrowths of the germinal epithelium. Their idea is that all the ova that a woman is to have during her life are formed at birth or shortly thereafter. The work of Allen in 1922 and the work of Swezy and Evans on ovogenesis in the mammalia throw doubt on this idea. Swezy and Evans summarized their findings as follows:

"Ovogenesis occurs throughout adult life in the guinea pig, cat, dog, and man, as a rhythmical process, during which thousands of ova are produced de
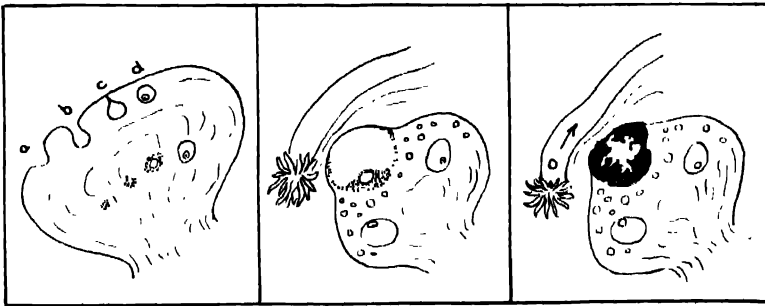
Fig. 16.   Fig. 17.   Fig. 18.

Fig. 16.—Diagrammatic illustration of the two methods of oogenesis. At *a, b, c, d*, various stages of the infolding of the germinal epithelium are seen. In the deeper portion of the ovary follicles are shown developing from the ovarian mesenchyme in this locality.

Fig. 17.—Ripened follicle at the surface of the ovary just before ovulation.

Fig. 18.—Follicle ruptured and corpus luteum of proliferation remaining. The ovum is seen in the tube on its descent to the uterus. (Crossen—*Synopsis of Gynecology*, The C. V. Mosby Company.)

novo, followed by the degeneration of all but a few which mature. In the guinea pig, cat, and dog this rhythm of ovogenesis coincides with the rhythm of the estrus cycle, beginning at ovulation and reaching its peak at anoestrum, with wholesale degeneration occurring at late prooestrum. Ovogenesis was proven in adult mice by Allen and Creadick. Using colchicine to arrest the cells in mitosis, they were able to demonstrate mitoses in the general epithelium of an adult mouse ovary. Lack of knowledge of a definite estrus cycle in man weakens the correlation here, but the rhythm of ovogenesis is as striking in the number of ova produced and destroyed as in the other animals.

"New sex cells are produced by proliferations from the germinal epithelium in the form of invaginations and ingrowths of epithelial cords. These become separated from the germinal epithelium, pass through the tunica albuginea and form a more or less continuous layer underneath the tunica. From one to many cells in each group may develop into ova, the remainder forming the follicle cells.
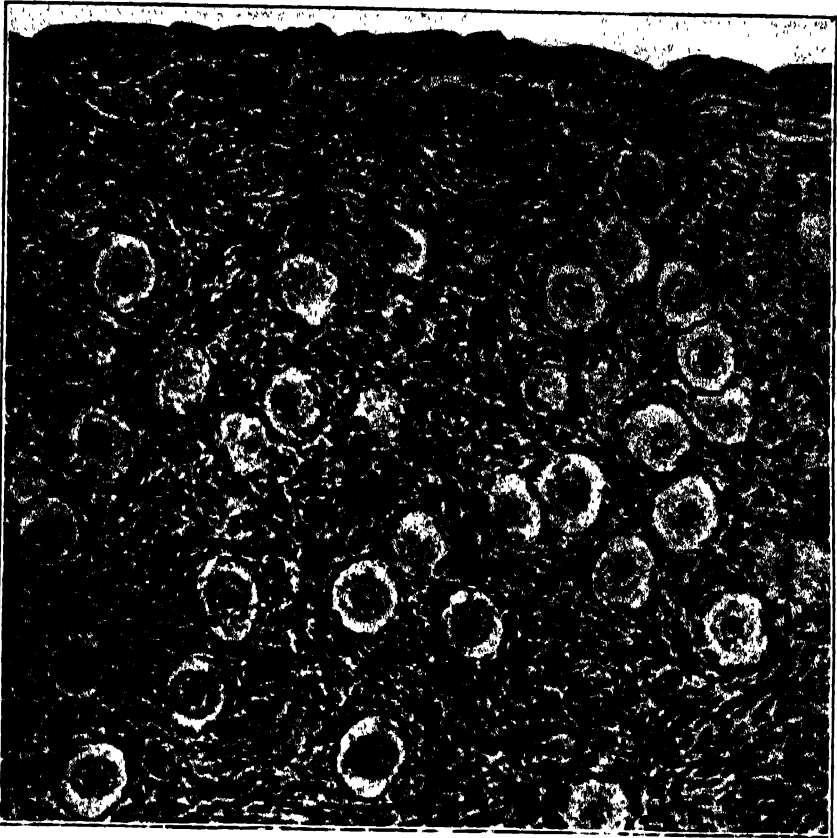
Fig. 19.—Primordial follicles. High power. Photomicrograph from ovary of child. Gyn. Lab.
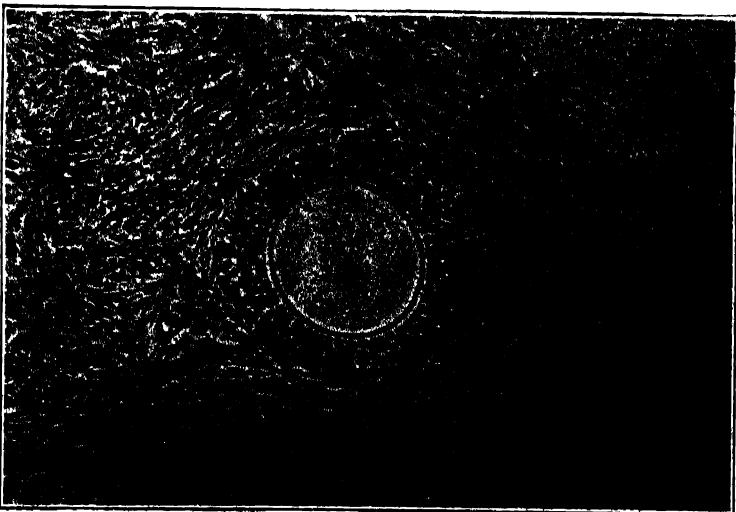
Fig. 20.—Adult ovary. Field showing a small follicle with contained ovum. Gyn. Lab.

"Contrary to the concept involved in the germ plasm theory, the mammalian ova (excepting those that mature and are fertilized) have a shorter life span than any other group of cells in the body outside of the reproductive tract."

More recently Fischell and also Politzer have arrived at the conclusion that the ova and follicular epithelium and granulosa cells are formed in loco from the ovarian mesenchyme, from which likewise are formed the thecal and stromal tissues of the ovary. It is probable that both of the methods of ovum- and follicle-formation are present in the human being.
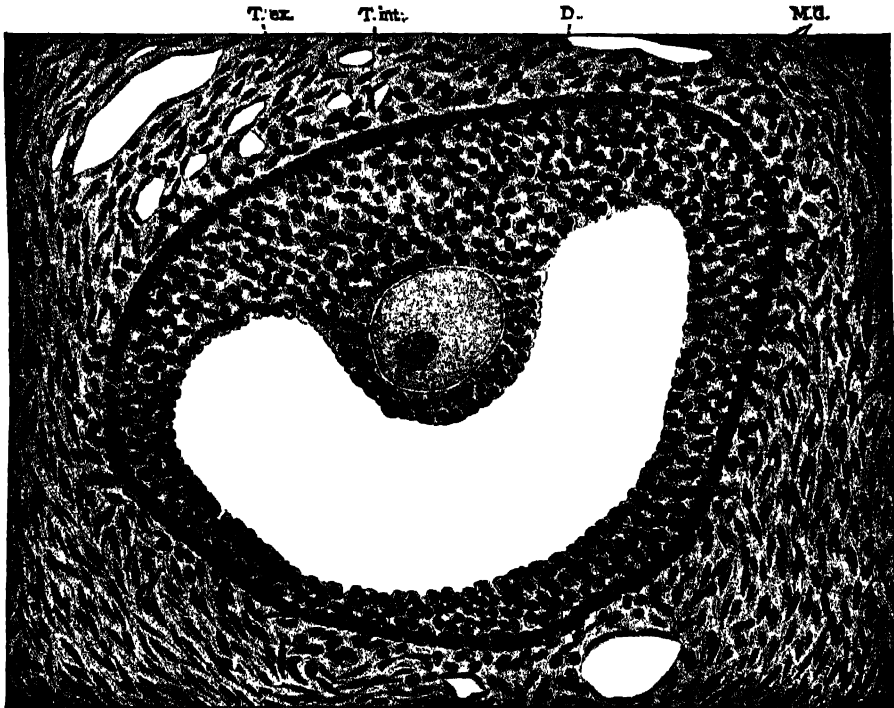
Fig. 21.—Drawing of a somewhat older follicle and contained ovum, to show the details of the follicular epithelium (membrana granulosa) and of the ovarian stroma, which is very rich in cells. The follicular cavity has begun to form. *M.G.*, membrana granulosa; *D*, discus proligerus; *T.int.*, theca interna; *T.ex.*, theca externa. (Williams—*Obstetrics*, D. Appleton-Century Company.)

The primordial **follicle** consists of an oocyte surrounded by a single layer of flattened epithelial cells (Fig. 19). As the child grows, the follicles develop further. In the adult, the first step toward a functioning follicle is the rapid proliferation of the epithelial envelope about the oocyte, which becomes several layers thick, as shown in Fig. 20. It is known that pituitary A (follicle-stimulating hormone) is one factor initiating this process of follicular development, but it is not known what causes this hormone to start functioning at this particular time.

In the developing epithelial layer, now called the **membrana granulosa,** a cleft appears and fills with fluid (Figs. 21 and 22). As this **liquor folliculi** increases, this cleft becomes a spherical cavity, as shown in Fig. 23. The fluid

Preceding the rupture of the follicle, certain changes are noted in its wall—changes which are indicative of maturation of the follicle. The cells of the theca interna become larger and clearer, gradually losing their connective tissue characteristics. All grades of transition may be noted between the spindle cells of the theca externa and the polygonal cells of the theca interna.
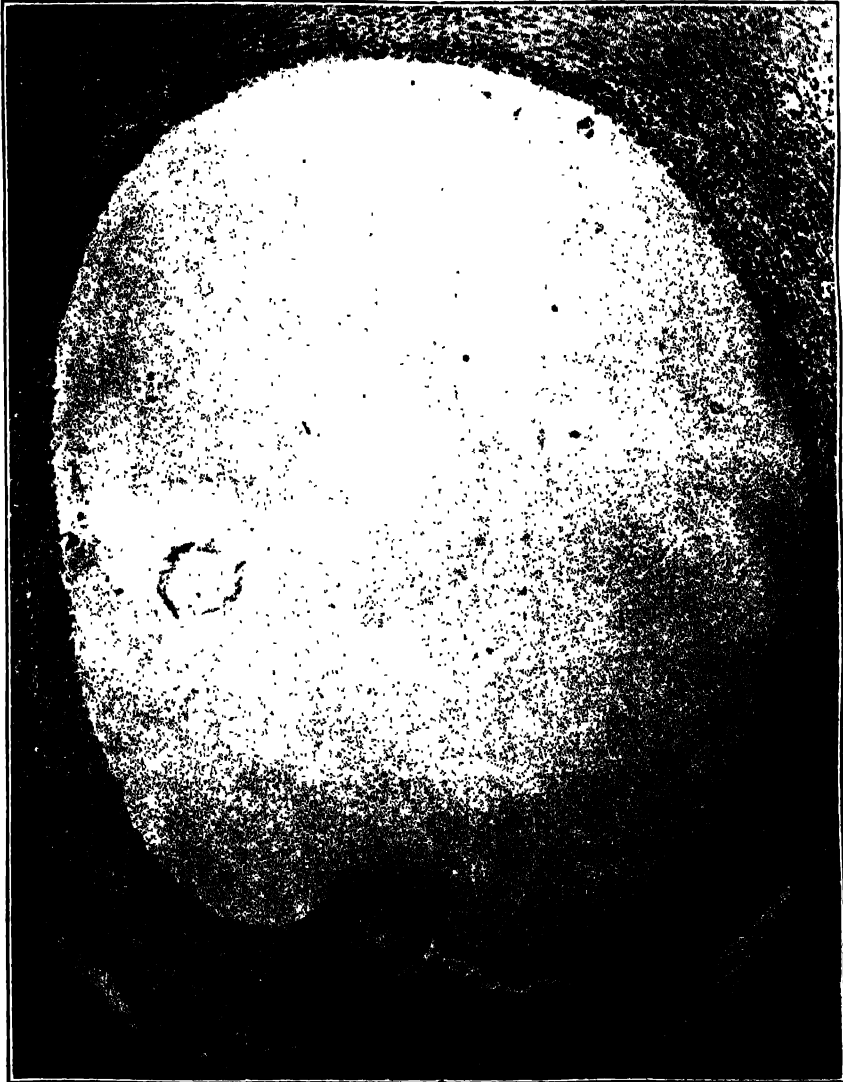
Fig. 23.—Photomicrograph of a follicle which is nearly mature, as indicated by the size of the cavity compared to the ovum. Gyn. Lab.

The theca interna separates itself from the membrana granulosa, which becomes increased in thickness. According to Strassmann, who studied 18,000 serial sections of ovaries of humans and animals, ovulation is a mechanical process stimulated by the endocrine glands, and the follicles reach the surface

of the ovary by the following mechanism. Through a one-sided proliferation of the theca interna on the side of the follicle nearest the surface of the ovary, a cone is formed which penetrates the surrounding tissue, thus opening a way for the developing follicle. The growing follicle ascends to the ovarian surface by following the line of least resistance provided by the cone of the theca interna. Figs. 26, 27, and 28 show the steps in the process.

A.

B.

Fig. 24-A and B.—A, Twin human ovum recovered on the fifteenth day of the menstrual cycle. Ovulation probably occurred on the preceding day. The other twin ovum is shown in Fig. 25. This ovum was recovered from the left tube. B, Camera lucida drawing of A. Note the polar body at ten o'clock. (Figs. 24 and 25 are from a monograph by Edgar Allen, J. P. Pratt, Q. U. Newell, and J. L. Bland, published by The Carnegie Institution.)

A.

B.

Fig. 25-A and B.—A, Twin ovum to that shown in Fig. 24, recovered from the right tube. Chromosomes of the second maturation spindle were located at eight o'clock. B, Camera lucida drawing of A.

The actual cause of the rupture of the follicle has been the subject of considerable speculation and the following theories have been proposed: (a) Smooth muscle fibers in the ovarian stroma contract rhythmically and eventually cause the follicle to rupture. There is little evidence to support this idea.

(b) An enzyme digests the internal lining of the follicle until it is too weak to withstand the intrafollicular pressure. No such enzyme has been found.
(c) An increased osmotic pressure in the follicular fluid probably caused by the disintegration of the Call-Exner bodies. In rabbits J. T. Smith has shown that the Call-Exner bodies migrate into the follicular fluid and disintegrate at the time of ovulation. He feels that these bodies contribute something, probably glycogen or sugar, which raises the osmotic tension of the follicular fluid. He has shown also that in the rabbit the osmotic tension in follicles about to rupture is greater than that in unstimulated follicles.

Much study has been given to the problem of determining when a patient ovulates. The following signs and symptoms have been proposed as indicative of ovulation:

1. Cervical mucoid discharge is frequently seen at the time of ovulation. Séguy and Simonnet consider it a constant and dependable sign.

2. Uterine bleeding, frequently associated with slight pains, occurs in about 5 per cent of women. The bleeding is usually very scanty and is probably due to a temporary drop in the estrin-blood level, with withdrawal bleeding, and stops as soon as the new corpus luteum secretes enough estrogen and progesterone to correct the blood level. The pain is probably due to the rupture of the follicle, and may be severe enough to cause an incorrect diagnosis of appendicitis.

3. On examination of the vaginal smear Papanicolaou found erythrocytes and a sudden increase in leucocytes in 31 per cent of his series of cases. Zuck and Duncan found that a rise of vaginal pH indicated ovulation.

4. Blood findings consist of a rise in estrin just before ovulation and there is an increase in prolan in the urine.

5. Premenstrual endometrial biopsy shows typical progestational effects, indicating that ovulation has occurred.

6. At operation, Cotte, Bissell, and others have noted 8 to 60 c.c. of free fluid in normally ovulating women, and it is thought that this may aid movement of the ovum. It is possible that this much fluid can be found in any abdomen. Noyt and Meigs and also Hendrickson found some blood in the peritoneal cavity at ovulation time. It varied from a few cubic centimeters to severe bleeding, causing shock.

7. Changes in electrical potential at ovulation time were noted by Burr, Hill and Allen in 1935 in rabbits. Rock, Reboul and Snodgrass previously felt that these same changes in the human subject indicated ovulation, but in later experiments with 10 women only 7 of the 10 women showing changes in electrical potential had ovulated.

8. Rubenstein was able to predict ovulation by a study of body temperature through the cycle. He found that there was a depression of temperature during the proliferative phase, reaching its low point just before ovulation. With ovulation the temperature rose half a degree F. in the first twenty-four hours and exceeded one degree for the first week after ovulation. Using this test correlated with the vaginal smear technique, he was able to discover that four of his sterility patients were ovulating during menstruation. He advised coitus on the estimated day of ovulation, and succeeded in securing pregnancy in all four women. Details of vaginal smear will be given under Vagina.

of the ovary by the following mechanism. Through a one-sided proliferation of the theca interna on the side of the follicle nearest the surface of the ovary, a cone is formed which penetrates the surrounding tissue, thus opening a way for the developing follicle. The growing follicle ascends to the ovarian surface by following the line of least resistance provided by the cone of the theca interna. Figs. 26, 27, and 28 show the steps in the process.

A.   *B.*

Fig. 24-*A* and *B.*—*A*, Twin human ovum recovered on the fifteenth day of the menstrual cycle. Ovulation probably occurred on the preceding day. The other twin ovum is shown in Fig. 25. This ovum was recovered from the left tube. *B*, Camera lucida drawing of *A*. Note the polar body at ten o'clock. (Figs. 24 and 25 are from a monograph by Edgar Allen, J. P. Pratt, Q. U. Newell, and J. L. Bland, published by The Carnegie Institution.)

A.   *B.*

Fig. 25-*A* and *B.*—*A*, Twin ovum to that shown in Fig. 24, recovered from the right tube. Chromosomes of the second maturation spindle were located at eight o'clock. *B*, Camera lucida drawing of *A*.

The actual cause of the rupture of the follicle has been the subject of considerable speculation and the following theories have been proposed: (a) Smooth muscle fibers in the ovarian stroma contract rhythmically and eventually cause the follicle to rupture. There is little evidence to support this idea.

Fig. 26.—Theca interna cone, first stage. Triangular thecal wedge, indicated by line, pointing toward ovarian surface. No theca layers around follicle otherwise, one layer of granulosa cells. Small follicle of a rabbit ($\times$325). (Strassmann—Am. J. Obst. & Gynec.)
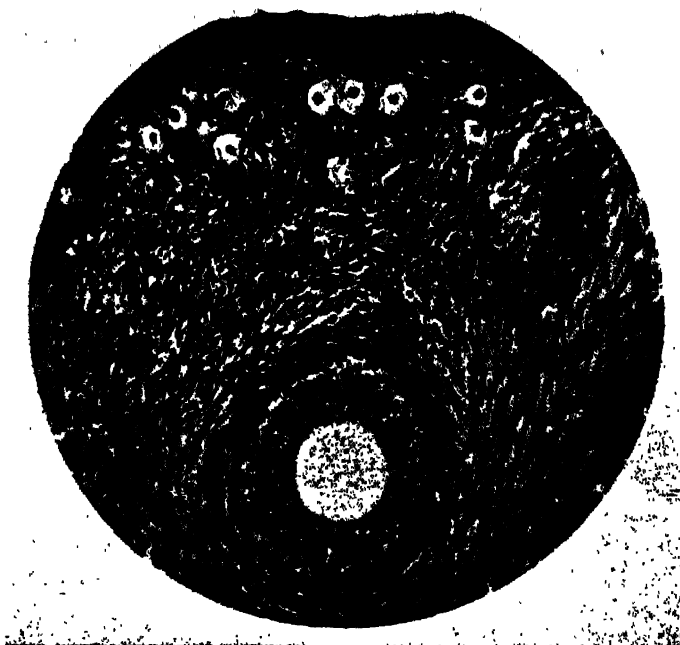
Fig. 27.—Theca interna cone, second stage, pointing toward ovarian surface. Beginning development of theca layers around follicle. Multiple layers of granulosa cells. Small follicle of a rabbit ($\times$100). (Strassmann—Am. J. Obst. & Gynec.)

After ovulation the **corpus luteum** is formed under the influence of pituitary B which is the luteinizing hormone. Corner found in monkeys that there is also luteinization of some unruptured follicles, and he calls these accessory corpora lutea. The stages of change as worked out by Novak have been very helpful in correlating the histologic changes in the corpus luteum with those in the endometrium. They are as follows:

1. The stage of Proliferation (fifteenth to eighteenth day). With evacuation of the liquor folliculi, the cumulus oophorus, together with its ovum, escapes into the peritoneal cavity. The capillaries of the theca interna and externa are widely dilated. The theca interna cells increase in size due to fatty infiltration. The granulosa cells become polygonal, take the stain less deeply, and are gradually converted into lutein cells.

Fig. 28.—Theca interna cone, third stage, and granulosa cone, coinciding axis pointing toward ovarian surface. Streamlined adaptation of stroma. Ascending follicle of a cow (×80). (Strassmann—Am. J. Obst. & Gynec.)

Grossly a very early corpus luteum appears as a thin-walled, collapsed vesicle on the surface of the ovary. The point of rupture may be evident, but hemorrhage into the lumen is not characteristic. The hyperemic wall does give the vesicle a hemorrhagic appearance. The inner surface is yellowish gray at this stage, and there is only a slight degree of undulation. Figs. 29 to 31 show corpora lutea in this early stage. Fig. 32 shows the three layers of the wall of an unruptured follicle—membrana granulosa, theca interna, theca externa—and Fig. 33 shows the corresponding layers in the wall of a corpus luteum in the stage of proliferation.

2. The stage of Vascularization (eighteenth to twenty-third day). This second stage in the development of the corpus luteum begins with hemorrhage into the granulosa layer and lumen from the dilated capillaries of the theca.

At the same time endothelial cells, from the vessels of the theca interna, push in between the granulosa cells centrally to the lumen of the corpus and form new capillaries in the epithelial zone.

Fig. 29.—Recently ruptured follicle showing rupture point with plug already formed in the opening. This is now a corpus luteum of proliferation. Gyn. Lab.

Fig. 30.

F.g. 31.

Fig. 30.—Corpus luteum of proliferation showing the arrangement of the three layers: theca externa, theca interna, and granulosa cell layer. Gyn. Lab.

Fig. 31.—Higher power of Fig. 30, taken from an area at the extreme left end of the wall. Gyn. Lab.

While vascularization is the most conspicuous feature of this stage, changes in the epithelium are also noted. The cells take on a more luteinlike character, and the epithelial zone is quite clearly marked off from the theca interna. Endothelial cells push beyond the inner border of the lutein layer into the extravasated blood in the lumen. Connective tissue cells also penetrate the
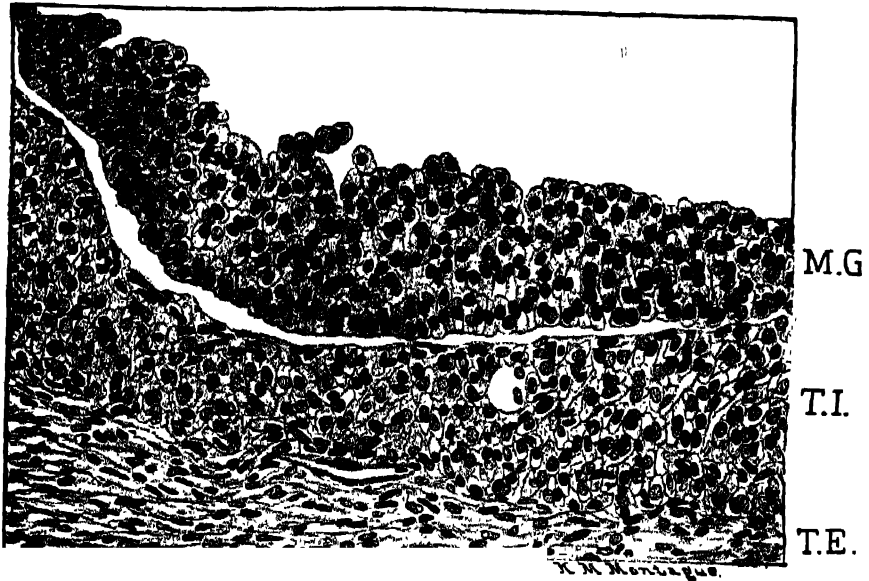
Fig. 32.—Lining of follicle before rupture. *M.G.*, membrana granulosa, the cells of which later form the lutein cells; *T.I.*, theca interna; *T.E.*, theca externa. (Williams—*Obstetrics*, D. Appleton-Century Company.)

Fig. 33.—Photomicrograph, corpus luteum of proliferation. High power, showing the cellular characteristics of the three layers. Notice the large theca interna cells filled with light staining lipoid substance. The capillaries of the theca interna are widely dilated and filled with blood cells. The sharp line of demarcation between the theca interna and the granulosa cells is easily seen. *M.G.*, membrana granulosa; *T.I.*, theca interna; *T.E.*, theca externa. Gyn. Lab.

lutein layer and invade the lumen. Gradually there is developed on this inner border a layer of connective tissue cells and blood vessels, which form a sharp dividing line between the lutein layer and the blood in the lumen. At this stage the wall becomes bright yellow and takes on a wavy outline. The theca interna cells shrink toward the end of this stage. Fig. 34 shows this second stage of corpus luteum development.

3. The stage of Maturity (twenty-third to twenty-sixth day). The completion of vascularization and the forming of the dividing line between the lutein layer and the contents of the lumen indicate that the corpus luteum has reached the stage of maturity (Fig. 35). Its function as an endocrine gland is now most evident, and it gives off its hormone into the blood stream instead of into the cavity. Fig. 36 shows the very large lutein cells of this stage. The lutein zone assumes a more marked undulating outline, owing to the rapid increase in these cells as compared to the surrounding tissue. The theca cells in the septa, at this stage, are large and take on an alveolar arrangement. In the gross section (Fig. 37) the corpus luteum in this stage is a conspicuous yellow body. The yellow substance in the corpus luteum is carotin and is identical with that found in carrots. On the surface of the ovary the corpus luteum appears as a dark red protuberance, which may be mistaken for a hemorrhagic cyst.

4. The stage of Retrogression (twenty-sixth to the fourteenth day of the next cycle). This stage starts shortly before menstruation and is characterized by a shrivelling of the lutein layer as a result of a development of connective tissue fibrils between the lutein cells. The process of organization of the contents of the lumen proceeds very rapidly. The theca interna becomes less distinct and disappears. As the process gradually advances, the stroma outside and the organized central core encroach on the shrinking wall of lutein cells, which show marked hyaline change. Little by little the lutein cells disintegrate, until finally there remains only the shrunken hyalinized outline of the wavy lutein layer, surrounding a central core of well-formed connective tissue. The structure is then white and hence is designated the "corpus albicans." It is called also the corpus fibrosum. Stages of this process are shown in Figs. 38 and 39. After many follicles have ruptured and passed through the various stages, the surface of the ovary presents many depressed scars, giving an irregular rough appearance.

ENDOCRINE RELATIONS

CONCERNED IN OVARIAN FUNCTION

The ovary has another function entirely distinct from that of supplying ova and yet intimately associated with it, namely, the endocrine function. It has been clearly demonstrated that this endocrine function of the ovary is under the control of the hormones of the anterior lobe of the pituitary gland. The pituitary-ovarian relationship is the essential factor which determines in the girl the growth and development of the reproductive organs occurring at puberty. The development of the secondary sex characteristics, both physical and psychic, is also due to the action of these hormones. Opinion is divided as to whether the ovaries exhibit any endocrine function before puberty,

T.I.

L.

C.
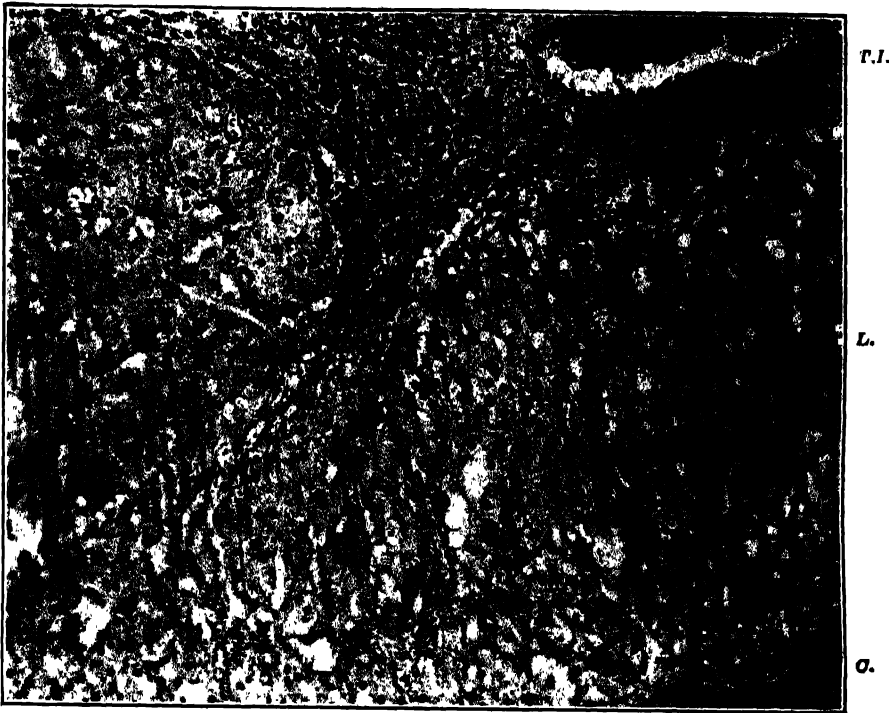
Fig. 34.—The theca interna cells have diminished in size due to a loss of their fat content. The capillaries of the theca interna are seen invading the granulosa layer, the cells of which have assumed a lutein character. In this luteinized layer the blood cells can be seen in capillaries and also lying free among the lutein cells. In the lower right corner of the figure a few endothelial cells can be seen invading the blood in the cavity. T.I., theca interna; L., lutein layer; C., cavity. Gyn. Lab.

Fig. 35.—Corpus luteum of maturity showing area of the upper wall near the center of the figure. Note the zone of connective tissue separating the lutein layer from the cavity. Gyn. Lab.

Tandler and Cross hold that they have been able to demonstrate differences in the two sexes long before the onset of puberty. Novak, however, takes the opposite view, stating not only that there is no endocrine function before puberty, but also that there is no ordinary tissue growth of the uterus and ovaries from birth to puberty, such as is seen in other structures of the developing child.
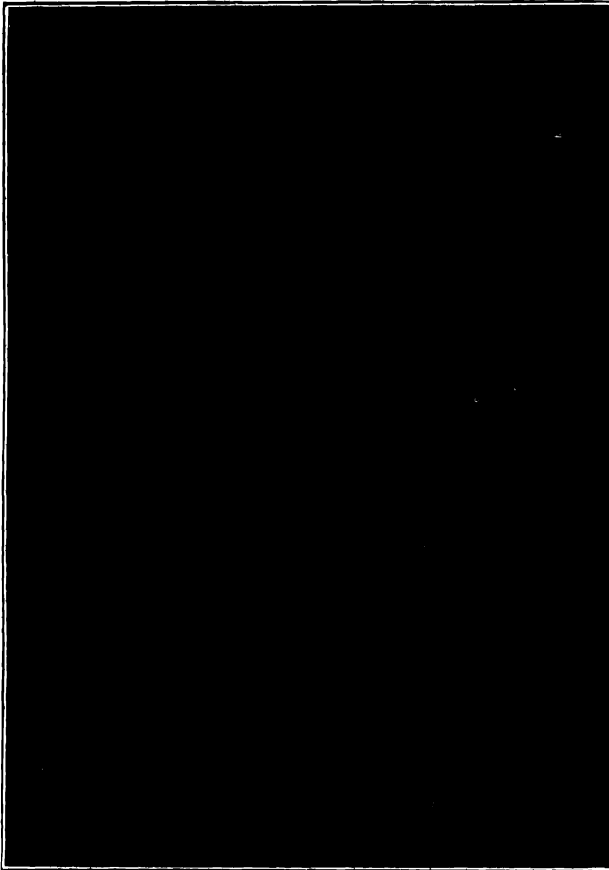
Fig. 36.   Fig. 37.

Fig. 36.—Corpus luteum of maturity, very high power, showing the septum formed by the theca interna (paralutein) cells. A large capillary is seen in the septum near the upper edge of the figure. The connective tissue cells lining the cavity are seen at the bottom of the figure. Gyn. Lab.

Fig. 37.—Normal adult ovary, showing a corpus luteum. Notice what a large part of the ovary is occupied by the corpus luteum. Gyn. Lab.

A concise summary of the known **endocrine relations** concerned in ovarian function will be given first. Later, a summary of the established facts concerning the various hormones, together with some of the steps in the development of this knowledge, will be given under the individual hormones.

With the onset of puberty and menstruation, a cycle of changes is set up involving the anterior pituitary and ovary and uterus, as indicated in Fig. 40. The factors initiating the onset of these cyclic changes are as yet not clearly understood.

Frank has shown that small doses of estrogen stimulate the pituitary gonadotropic function while larger doses inhibit it, hence it is possible that as adolescence approaches, the estrogen from the partially developed follicles at first stimulates and then, as the amount of estrogen increases, inhibits the production of the gonadotropic hormone. This gonadotropic hormone is the product of the basophilic cells in the anterior pituitary. In this summary the gonadotropic hormones directly from the pituitary are designated pituitary A or F.S.II., and pituitary B or L.H.

As shown in Fig. 40, pituitary A starts the follicle ripening and incites the granulosa cells to produce estrogen which in turn induces the growth phase of the endometrium. After full development of the follicle, ovulation occurs and a corpus luteum is developed from the ruptured graafian follicle. The
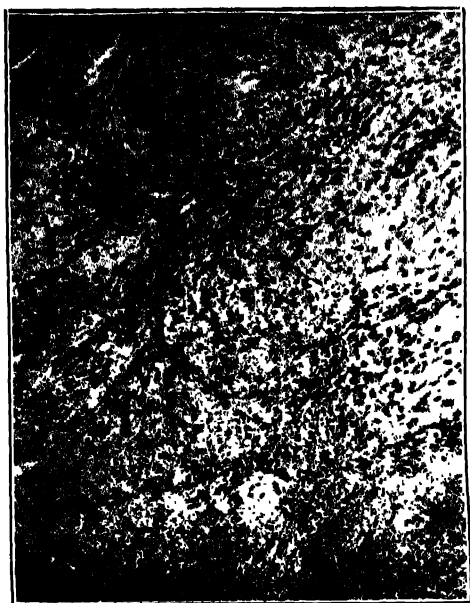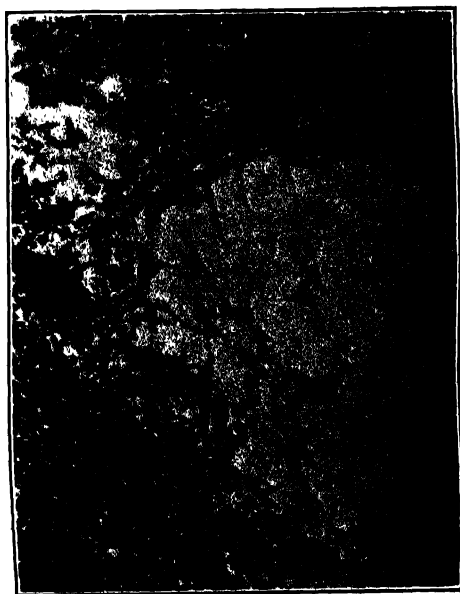
Fig. 38.   Fig. 39.

Fig. 38.—Corpus luteum in the early stage of retrogression. Connective tissue fibrils can be seen invading the shrivelled lutein layer. Connective tissue fibers can also be seen invading the cavity at the lower border of the figure. The lutein cells still retain their nuclei. Gyn. Lab.

Fig. 39.—Corpus luteum in the late stage of retrogression. The lutein cells have lost their nuclei and the remaining hyaline-like mass is being invaded by connective tissue fibers. Gyn. Lab.

action of pituitary B luteinizes the granulosa cells and incites them to produce the progesterone which, in conjunction with estrogen, causes the premenstrual or secretory phase of the endometrium.

The amount of the follicular hormone formed increases rather steadily through the cycle, reaching its highest peak just before menstruation. There is a slight drop in the blood estrogen at the time of ovulation. Estrogen inhibits the production of the gonadotropic hormone of the anterior pituitary. Consequently, as the level of estrin rises in the blood, there is a corresponding decrease in the secretion of pituitary A and B. When this decrease in the amount of the gonadotropic hormones becomes so marked that it is insufficient to maintain the corpus luteum, the latter undergoes retrogression. This results

in a cessation of estrogen production. The sudden withdrawal of estrin and progesterone causes a breaking down of the built-up endometrium, resulting in a flow of blood and débris (menstruation). The decrease of estrin in the blood now removes the inhibition on the anterior pituitary, allowing the basophilic cells to produce the gonadotropic hormone again. This stimulates a new follicle to develop,·initiating a new cycle.
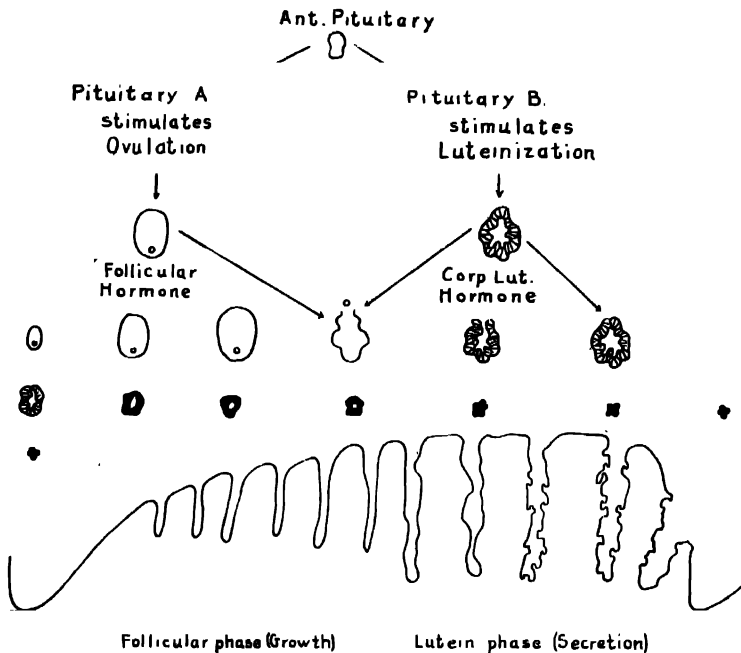
Fig. 40.—Schematic drawing showing the various hormones acting on the endometrium in their time relation. This represents a nonfertile cycle. (Crossen—*Synopsis of Gynecology*, The C. V. Mosby Company.)
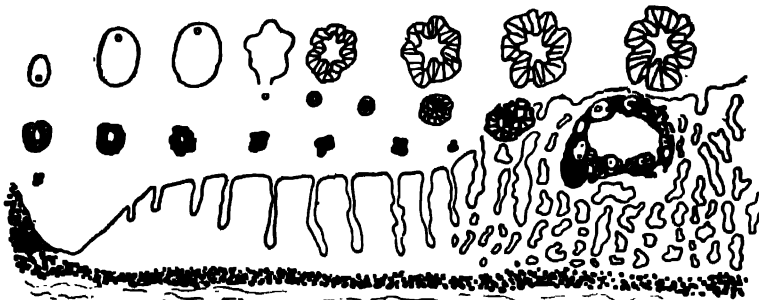
Fig. 41.—This represents the events occurring when pregnancy ensues. Ovum embedded, decidua formed, and corpus luteum enlarged and active. (After Schröder.)

In the event of pregnancy (Fig. 41) hypophyseal suppression persists, and the cyclic activity is held in abeyance throughout the gestation period. The corpus luteum continues to enlarge and its hormone, together with estrin, prepares the endometrium for the reception and the embedding of the fertilized ovum. A new factor is introduced in pregnancy, namely, the placenta. Collip and others have shown the placenta to be a very important source of the follicular hormone and of a hormone similar in some respects to the gonadotropic

hormone of the pituitary... The corpus luteum hormone was obtained from the placenta by Adler. The placenta probably takes over the production of progesterone after the third month of pregnancy, and the amount increases up to the end of the ninth month. The placental hormones will be discussed in more detail later.

OVARIAN HORMONES

The fact that the gonads were endocrine organs was first proved in 1849 by Berthold. He showed that the secondary changes caused by castration of cockerels could be avoided by implanting the removed testicle in the castrate. Very little was added to this knowledge until 1896 when Knauer showed that implantation of the ovary in castrates prevented atrophy of the uterus. In 1900 Halban demonstrated that the anatomic and physiologic development of the genital organs are governed by the endocrine function of the ovary. He caused normal puberty changes in immature castrated guinea pigs by implanting of ovaries subcutaneously. In 1904, the importance of the ovarian interstitial tissue was brought out by Limon. In successful ovarian grafts the follicles usually degenerated, showing that the success is not entirely due to the ova-producing mechanism. Adler in 1912 was the first to cause sexual activity in castrated females by injecting aqueous extracts of ovarian tissue and Iscovesco was the first to obtain an active alcoholic ovarian extract.
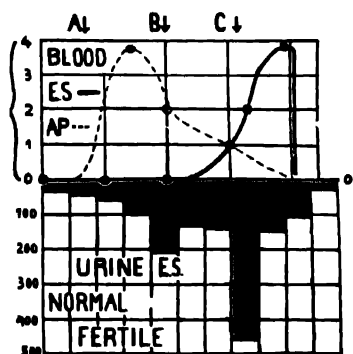
Fig. 42.
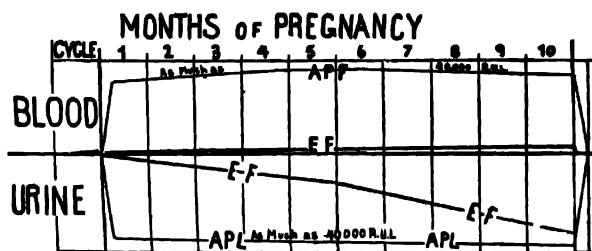
Fig. 43.

Fig. 42.—Hormone cycle (female sex hormone and anterior pituitary) of normal fertile menstruating woman. (Frank—*J. A. M. A.*)

Fig. 43.—Stupendous increase of hormone production and excretion produced by pregnancy. Not to scale—the cyclic readings are exaggerated, the pregnancy curve is reduced. (Frank—*J. A. M. A.*)

Follicular Hormone

New impetus to the study of the ovarian hormones was added by the discoveries of Stockard and Papanicolaou. They ascertained that ovulation in guinea pigs is accompanied by marked hypertrophic changes of the vaginal epithelium, which are easily detected by microscopic examination of the vaginal smear. The importance of this discovery becomes obvious when one realizes that most of the subsequent research work on ovarian hormones was done in laboratory animals and estimation of results was dependent upon this test of function. This test was confirmed in other laboratory animals by Allen, Long and Evans, and by Pelkan. In animals that show periodic sexual exhibitions, as the dog and cat and pig, this test was not needed nor was it necessary in the monkey where menstruation occurs.

Later Allen and Doisy made the significant discovery that an extract of the follicular fluid, when injected into a castrated mouse, caused changes in the morphology of the vaginal epithelium and discharges indicative of estrus. They were the first to supply a simple specific biologic test for this estrus-producing hormone and to determine a standard unit. The latter represents the smallest quantity of the specific hormone capable of producing the vaginal changes referred to above. Frank discovered the presence of the sex hormone (estrin) in the blood of normal women. He found that the amount in 40 c.c. of blood in the normal menstruating fertile woman is less than one mouse unit until seven days before the period after which it rises rapidly and reaches its maximum, of about four mouse units, just before the period. With the onset of menstruation there is an abrupt fall of the hormone level in the blood to zero. He has also determined the excretion of this estrus-producing hormone in the urine during the normal menstrual cycle. He found an increase in excretion on about the tenth day, followed by a fall and a subsequent rise to a maximum on about the twenty-fifth day; the fall to zero occurred about three days after the onset of the period. The normal monthly output is from 1,200 to 1,500 mouse units, the maximum in a single day being about 450 mouse units. The charts by Frank show the blood and urinary levels during a normal cycle (Fig. 42) and also during pregnancy (Fig. 43).

It was discovered by Aschheim and Zondek that enormous quantities of this hormone are excreted in the urine of pregnant women, the concentration varying from 600 to 10,000 mouse units in every 1,000 c.c. of urine. The hormone was also found in the feces during pregnancy, in the blood of the newborn child, in the amniotic fluid, and in the saliva, breast milk, and blood of the mother. Its occurrence is not limited to the female, for it is found in men as well as in women; nor is it found only in the animal kingdom, for it has been extracted from potatoes, wheat, sugar beets, yeast, and petroleum.

Hormone storage does not occur in the body, so the response of an organ depends upon the maintenance of a minimum hormone level or threshold dose for a period of time sufficient to give the response.

There has been much investigation to determine the sites in the ovary for formation of hormones. In a review of these investigations Corner concluded that, notwithstanding the large amount of investigative work, information as to the sites of estrogen formation is not yet complete. The general conclusion seems justified that the estrogen found in the ovary and blood and urine of the non-pregnant female is probably formed by the theca interna of follicles of all sizes, and the estrogen found in the placenta and blood and urine of the pregnant female of certain species is produced in all probability by the placenta.

The isolation of the crystalline form of the follicular hormone was accomplished almost simultaneously by Doisy in this country and by Butenandt in Germany, in 1929. Doisy gave this pure product the name of theelin, and described it as ketohydroxyestrin. The present accepted designation is estrone or theelin. The hydrated form of theelin, estriol, is a trihydroxyestrin and differs from theelin in its estrogenic potency. Later, by hydrogenation of the keto-hydroxyestrin molecule, a dihydro compound was formed possessing four times

the potency of theelin. This was called estradiol and it exists in the alpha and beta forms. This was accomplished by Schwenk and Hildebrandt. The chemical relationships are shown in Figs. 44 and 45.

More recent compounds are the benzoic monoester of a-estradiol and the a-estradiol dipropionate. The potency of these estrogens per unit weight is in the following order, beginning with the least potent, estriol, estrone, estradiol benzoate, estradiol dipropionate, estradiol. If they are considered for duration of effect, the sequence is estriol, estrone, estradiol, estradiol benzoate, and last estradiol dipropionate, having the most prolonged effect.

Trihydroxyestrin
(Theelol)

Keto hydroxyestrin
(Theelin)

Dihydro - compound
(Progynon - B)
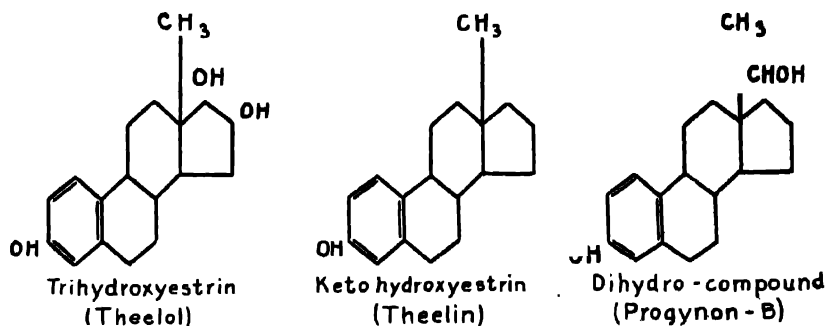
Fig. 44.—Chemical formulas of the various estrogenic substances.

CHOLESTEROL

PREGNANDIOL

MALE SEX HORMONE

CORPUS LUTEUM HORMONE

THEELOL

THEELIN
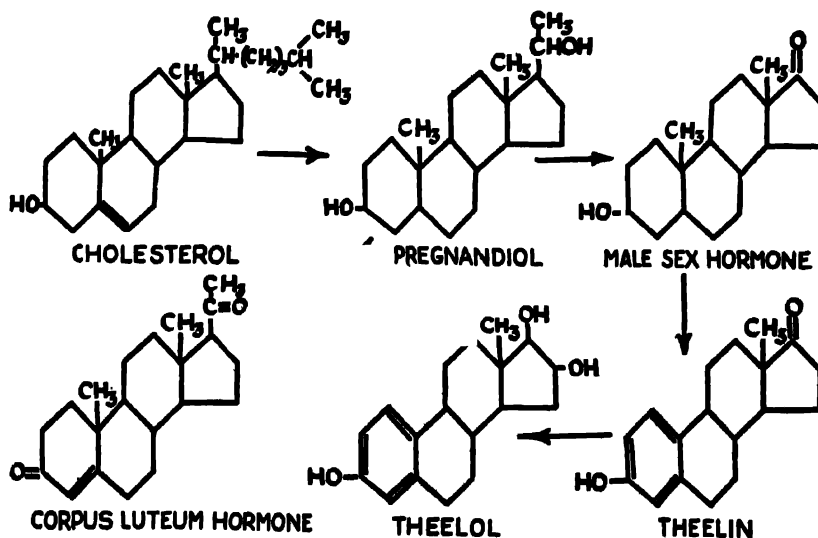
Fig. 45.—Chart showing the close chemical relationship of estrin to other substances. This is particularly interesting in view of the efforts being put forth to make the various hormones synthetically. (Parke, Davis and Co.—*Therapeutic Notes.*)

Stilbestrol, a synthetic substance related to the stilbenes, though not an estrogen, has been shown to produce many of the effects of the natural estrogens. It is inexpensive compared to the cost of the estrogens and is effective by oral administration. The disagreeable side-effects (nausea, dizziness, etc.) can usually be avoided by limiting the dose to 0.5 mg. daily, and giving it at bedtime. Two other synthetic preparations with estrogen effect are octofollin and hexestrol, supposed to have less of the disagreeable effects (see page 219).

An important recent accomplishment in the sex hormone field, from the chemical standpoint, was the synthetic creation of a natural estrogen from simple starting material. This was accomplished by Bachmann, who from simple materials made synthetic equilenin, which occurs as a natural estrogen in the urine of pregnant mares.

The Physiologic Actions of the Estrogenic Hormone
(Estrin, Follicular Hormones, Estrogens)
(Theelin or Estrone, Estriol, Estradiol, Estradiol Benzoate, Estradiol Dipropionate)

1. Promotes development of the secondary sex characteristics.

2. Promotes growth and vascularization of the uterus, controls the growth phase of the endometrium, and helps to control the progestational phase.

3. Produces estrus in normal or castrated, mature or immature, mice.

4. Inhibits the production of the gonadotropic hormone of the anterior lobe of the pituitary gland, by causing agranulation of the basophilic cells. In castrated animals the effect on these basophiles, explained under the gonadotropic hormone of the pituitary (Figs. 46 and 47), can be prevented by injection of theelin. In this indirect way it inhibits ovulation.

5. Withdrawal of the follicular hormone is thought to be one of the factors causing the onset of menstruation.

6. Contractions of the uterine and tubal musculatures are stimulated by estrin. It also sensitizes the uterine muscle to the action of pituitrin.

7. It inhibits the action of progestin on uterine and tubal muscle.

8. Hisaw and others produced uterine bleeding in castrated monkeys. The endometrium showed no premenstrual changes. They later used theelin injections followed by progestin and produced menstrual-like bleeding with progestational changes in the endometrium.

9. In monkeys and in human beings, excessive doses of theelin have caused hyperplasia of the endometrium.

10. It causes a marked elongation of the milk ducts of the mammary gland and an increase in the number of primary buds in the alveoli. The epithelium covering the nipple is also thickened.

11. It inhibits lactation by its inhibitory influences on the lactating hormone of the anterior lobe of the pituitary, and also by its local action on the breast. Both actions are present during pregnancy, where there is marked breast development and preparation for lactation but no lactation until withdrawal of theelin after the delivery of the placenta. Estrin may be a factor in the etiology of breast carcinoma.

12. Overholser and Allen produced atypical growth of cervical epithelium in monkeys by the prolonged administration of estrin in combination with chronic trauma. Loeb, Suntzeff, Burns and Moskop produced precancerous changes in the cervix of a mouse by estrogen administration. Later, Gardner, Allen and others produced cervical cancer in mice in the same way, and they

successfully transplanted these tumors in male and castrated female mice. Estrin may be a factor in the etiology of cervical carcinoma.

13. Estrin passes through the placenta into the fetal circulation and affects the genital organs of the fetus. The occasional finding of secreting breasts and uterine bleeding in the newborn is attributed to the sudden withdrawal of the maternal estrin at birth. A test for prediction of sex is based on the placental permeability to the male and female hormones.

14. Werner, and later Kaufmann, caused uterine bleeding in human castrates by huge injections of estrin, but curettage showed no premenstrual changes. Kaufmann gave from three to ten million international units over a period of months to five patients with primary amenorrhea, some with uteri smaller than a hazelnut. In these women he succeeded in causing the uteri to increase to normal size. Some of the patients had short periods of bleeding. Werner used theelin. Kaufmann used a dihydro compound (progynon B).

15. Kaufmann produced a typical Swiss-cheese hyperplasia in a human castrate by using huge estrin dosage. Crossen (R. J.) has produced advanced precancerous changes in the endometrial glands of an older mouse, using estrogen. Estrin may be a factor in the etiology of adenocarcinoma of the fundus. Nelson produced myoma in guinea pigs by estrogenic administration.

16. Kaufmann caused the formation of a premenstrual-like endometrium, in a human castrate by using estrin and progesterone. This is discussed under the corpus luteum hormone.

17. Werner attempted to cause lactation in human castrates by giving theelin, corporin, and prolactin in the proper sequence. He was unable to obtain lactation, although some of the women had marked enlargement of the breasts and felt as though they were about to lactate.

18. Estrin is responsible for the series of changes in the organism which tend to facilitate coitus and fecundation and to create a special state of libido, varying in degree according to the species.

19. It causes hyperemia of the nasal mucous membrane.

20. It increases the tone of the vesical muscle.

Corpus Luteum Hormone

The enthusiasm caused by Allen and Doisy's work led many workers in this field to forget the importance of the corpus luteum as an internal secretory organ. Some went so far as to claim that the follicular hormone was the only hormone of the ovary, and Frank suggested that it be called the female sex hormone. The fallacy of this idea will be shown by tracing the development of our knowledge of the corpus luteum hormone.

The first to suggest that the corpus luteum elaborated an internal secretion was Gustav Born. He noted that in placental mammals the corpus luteum reaches its peak of development at the time when the placenta is beginning to form, and from the first days of pregnancy a decidual reaction begins in the stromal cells of the endometrium. He suggested that the internal secretion of the corpus luteum prepared the endometrium for reception and embedding of the ovum. Born died before proving his theory, and the work was con-

tinued by L. Fraenkel. In 1903, he proved Born's hypothesis conclusively by showing that in rabbits when the corpus luteum is cauterized or removed within six days after coitus (ovulation), pregnancy did not occur.

In 1907, Leo Loeb showed that the corpus luteum hormone sensitizes the endometrium so that irritation of any kind will cause decidual growth. Using guinea pigs, after an unfertilized ovulation (copulation with vasectomized buck), he inserted a foreign body into the uterine cavity on the day on which the embryos would have become implanted if the animal had been pregnant. In each case a tumor of decidual cells was formed at the site of irritation. This result could not be produced at any other time in the cycle, nor could it be obtained if the corpus luteum was removed or cauterized.

In 1929, Corner proved conclusively the dual secretory function of the ovary and established a test for the corpus luteum hormone. He removed the ovaries or cauterized the corpora lutea in rabbits from fourteen to twenty hours after mating, at which time the fertilized ova are in the tubes. No decidual changes occurred in the endometrium and none of the embryos lived after the fourth day. This demonstrated again the dependence of the endometrium on the corpus luteum for production of the premenstrual or progestational stage.

The following test for the presence of corpus luteum hormone was then proposed. A doe rabbit is mated and eighteen hours later is subjected to removal of both ovaries and to excision of a small portion of the uterus. Corpus luteum extract is then administered for five days and on the sixth day after mating the animal is killed, the embryos are recovered if present, and the uterus is examined microscopically and compared with the specimen removed at castration. With administration of the extract the uterus undergoes changes indistinguishable from characteristic progestational changes and identical with normal pregnancy of the fifth or sixth day. When the experiment was repeated, using follicular fluid instead of corpus luteum, no progestational changes occurred. W. M. Allen and Corner carried castrated rats to term, using corpus luteum injections, while the controls invariably aborted. Corner named this hormone progestin.

Hisaw in 1927 isolated a crystalline fraction from an extract of cow corpora lutea which causes relaxation of the pelvic ligaments characteristic of pregnancy in guinea pigs. He also has isolated a noncrystalline fraction which causes the characteristic progestational changes in the endometrium. Hisaw named the former relaxin and the latter corporin.

Certain other facts pertaining to the ovarian hormones are of interest. That the corpus luteum has an inhibiting effect on menstruation has long been known clinically. Its removal at operation during the premenstrual phase causes precipitate menstruation. Persistent corpora lutea in cows prevent ovulation and cause sterility, both of which are corrected when the corpus luteum is destroyed. Estrus and ovulation can be prevented experimentally by injection of extract of the corpus luteum. It is evident then that estrogens and progestin have antagonistic effects, though they are synergistic when used in proper time-relation in promoting normal ovulation and menstruation.

This teamwork between the follicle hormone and the corpus luteum hormone has been demonstrated in numerous ways. Corner and Hartman, working separately, found that in primates there are two types of cyclic uterine bleeding, one in which ovulation does not occur, and one in which ovulation takes place and a corpus luteum is formed. With the former type there are no premenstrual changes in the endometrium while with the latter type, where a corpus luteum is present, typical premenstrual changes occur. They injected an estrogenic hormone into castrated monkeys and caused endometrial bleeding, but there was no premenstrual proliferation (lutein phase) of the mucosa. Hisaw next sensitized the mucosa in castrated rats by follicular injections and followed this with a series of corpus luteum injections (progestin), and in this way caused typical premenstrual-like proliferation of the mucosa. Hisaw and Leonard sum up the situation thus: ''The function of the follicular hormone seems to be that of putting the uterus in the proper physiologic condition so it can respond to the corpus luteum hormone. Neither of these substances can produce progestational proliferation in the castrate uterus when given alone. If, however, it is first brought into condition typical of estrus through the injection of follicular hormone, and is followed immediately by corpus luteum treatment, progestational-like proliferation results.''

According to Llinás, the evolution of the corpus luteum depends on whether pregnancy occurs or not. In any case it is divided into two stages: (1) an anabolic stage or stage of development which, in woman, lasts twelve days in the corpus luteum of menstruation and from three to four months in the corpus luteum of pregnancy, and (2) a catabolic stage or stage of regression which in pregnancy lasts until delivery.

During the anabolic stage of the corpus luteum certain changes take place in the genital organs which tend to favor the reception, implantation, and nutrition of the fertilized ovum.

During the catabolic stage of the corpus luteum all of the changes in the genital organs disappear and the organs return to normal. This regression occurs rather suddenly, and in woman and certain anthropoids is responsible for the menstrual flow due to the shedding of the congested mucosa.

During the first three months of pregnancy the corpus luteum determines the maintenance of the ovum in situ, and after that the placental progesterone takes over this function.

Progesterone has been extracted from the placenta, corpus luteum, and adrenal cortex. It was crystallized almost simultaneously by Willard M. Allen, Butenandt, and several others. It has never been secured in the urine, but it is thought that pregnandiol glycuronidate represents the end product of its secretion.

The Physiologic Actions of the Corpus Luteum Hormone
(Progestin, Progesterone)

1. Together with estrin it controls the secretory or premenstrual phase of the endometrium and prepares it for the reception and embedding of the fertilized ovum.

2. It is essential for the conservation of early pregnancy before the placental progestin is present. The anabolic phase of the corpus luteum lasts during the first three or four months of pregnancy, after which time the placenta supplies the progestin.

3. It has been shown independently by Loeb, Papanicolaou, and Macht that it inhibits ovulation. It is thought by some that this action is an indirect one accomplished through inhibition of the anterior pituitary gland. Moore states that the direct evidence of the action on the pituitary gland is lacking.

4. It inhibits the contraction of the uterine muscle and maintains it in the state of comparative quiescence during pregnancy. It also inhibits tubal contractions, being antagonistic in its action to estrin and pituitrin in both tubal and uterine effects.

5. Corner and W. M. Allen have produced a premenstrual-like endometrium in castrated rabbits by using estrin and progestin in the proper sequence; this had previously been done in castrated monkeys by Hisaw and others.

6. It stimulates the development of the mammary gland beyond the degree secured by estrin, the chief effect being on the acini.

7. According to G. Van S. Smith, it is needed for the conversion of estrone to estriol for excretion by the kidneys.

8. Progesterone is probably excreted as pregnanediol glucuronide as observed by Vennig and Browne.

9. When supplied, it can prevent estrogen-withdrawal bleeding.

10. Progesterone-withdrawal bleeding occurs with a shorter latent period than does that from estrogen withdrawal. It may be delayed by estrogen administration.

Demonstration of the effect of the corpus luteum hormone on the human endometrium in the castrate resisted all efforts until Kaufmann's work in 1932. He succeeded in producing a premenstrual-like endometrium in a human castrate by using in their proper sequence estrin and the corpus luteum hormone. In forty cases of secondary amenorrhea he produced menstrual-like bleeding by the same means.

In the castrate case the total amount of estrogen used was 1,000,000 international units. In order to get the concentration needed in a small dose of liquid for hypodermic use, he used the dihydro compound obtained by hydrogenation of the ketohydroxyestrin (Schwenk and Hildebrandt). He used 35 rabbit units of progestin in the form of proluton.

In the first trial, curettage was done without waiting for menstruation, and a typical premenstrual-like endometrium was obtained. The experiment was repeated without curettage, and the bleeding started two days after the last injection of the corpus luteum hormone. Pieces of the discharged endometrium showed markedly convoluted glands, and an abundance of glycogen was demonstrated in the glandular epithelium, indicating that the glands were in a condition of marked functional activity.

In the cases of secondary amenorrhea the following plan was used: on the first, fourth, eleventh, and fifteenth of the month 50,000 mouse units of progynon were given intramuscularly. This was followed on the nineteenth, twentieth, twenty-second, and twenty-third days of the month by 10 rabbit

unit doses of progesterone (corpus luteum hormone). Menstrual-like bleeding always occurred within a few days after the last injection. W. M. Allen has shown that a similar effect can sometimes be obtained by the use of progesterone alone.

The very important question arises here as to whether the help given these patients assisted them to ovulation and corpus luteum formation and resulting menstruation (normal preparation for pregnancy) or only to nonovulation bleeding. Probably some of the patients attained to ovulation and others did not—a vital difference in trying to overcome sterility. This brings up the problem of determining in a given case, under treatment resulting in a bloody flow at times, whether or not ovulation is taking place. It also emphasizes the need of a distinctive term for nonovulation bleeding, instead of confusing it with menstruation, which has long implied, and should continue to imply, ovulation and corpus luteum formation with resulting preparation of the endometrium for pregnancy. This point is further considered under Physiology of the Uterus.

Male Hormone

Under gonadal hormones the androgens must be included. We now know that the ovary secretes some male hormone, and in both sexes hormones of the opposite sex are found in the blood and excretions. Hence these hormones are not sex specific. Some of the androgens and adrenal cortical extracts show estrogenic and progestational activity. These effects of the androgenic substances in the female rat are as follows: suppression of estrus cycles, increase in size of uterus, prevention of uterine atrophy after castration, and luteinization of the ovaries. In the monkey it inhibits menstruation, as it does also in the human subject. Some of the undesirable effects in the human being are deepening of the voice, enlargement of the clitoris, and excessive hair growth. Some of these actions are indirect, through inhibition of the pituitary.

GONADOTROPIC HORMONES

These two groups of hormones stimulate the gonads to functional activity and hence are referred to as the gonadotropins. First, there is the group derived from the anterior portion of the pituitary. These are found normally in the blood and urine of both men and women, and in increased amount after natural or artificial menopause. Second, there is the group derived from chorionic cells (placental hormones). These are found in the blood and urine of women with normal or abnormal pregnancy, and in the blood of pregnant mares.

Pituitary Gonadotropins

A great step forward in the knowledge of sex physiology was the demonstration of the fact that the anterior lobe of the pituitary gland controls ovarian function. Long and Evans had produced luteinized atretic follicles and delayed estrus and ovulation, by injections of alkaline extracts of beef pituitary. Smith and Engle caused true ovulation, with luteinization of atretic follicles coupled with growth stimulation to the degree of gigantism, by re-

peated anterior lobe pituitary transplants in immature mice. Aschheim and Zondek produced a predominance of luteinized atretic follicles and hemorrhagic follicles by implanting single grafts of the anterior lobe of the pituitary in immature mice. A separation of the anterior lobe extracts into folliclestimulating and luteinizing components was first accomplished by Fevold, Hisaw, and Leonard.

It now seems well established that the basophilic cells of the anterior lobe of the pituitary elaborate the gonadotropic hormone. These cells, as well as the acidophilic cells, are formed by the process of granulation from parent nongranulated cells called the "chromophobes." Normally basophiles are being produced continually by the appearance of granules in the chromophobes and, simultaneously, the basophiles are being changed back into chromophobes by the disappearance of the granules, as indicated in Fig. 46. The

Chromophobe

Granulation

Agranulation

Basophile

Estrin inhibits granulation.

Gonadotrophic h. stimulates ovary.

Normal Cellular Cycle

Fig. 46.

Granulation

Basophiles

Excess Gonadotrophic h. to blood and urine.
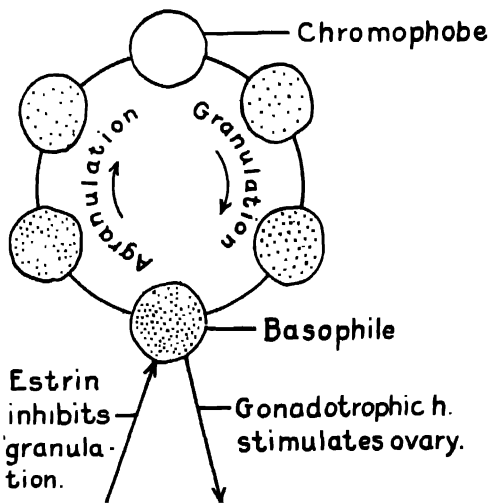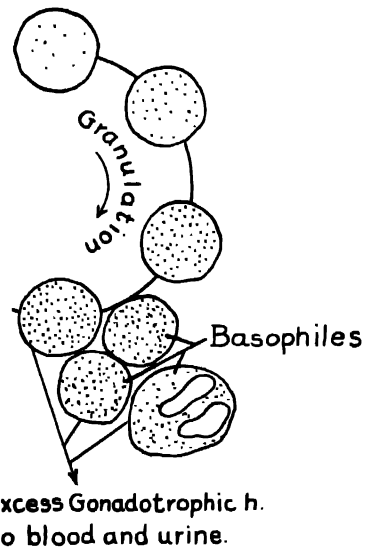
Castrate Cellular Cycle

Fig. 47.

Fig. 46.—Normal cycle of the basophile in the anterior lobe of the pituitary gland. The basophile is formed by granulation of the chromophobe. The action of estrin inhibits granulation and initiates the process of agranulation, whereby the basophile is changed back to a chromophobe.

Fig. 47.—Basophilic cycle in the castrate. The estrin influence has been removed, hence excessive granulation and no agranulation are the result.

rate of granulation and degranulation is controlled by the estrin level in the blood. Removal of the ovaries removes this control of the balance in the rate of basophile formation and return to chromophobes, with the result that there is not only a more rapid granulation rate, with increased formation of basophiles, but also the ability to degranulate is lost. This marked change from the normal cellular cycle is indicated in Fig. 47. The basophiles not only increase in number but also increase in size and show a tendency to become vacuolated. As a result of this there is an increase in production of the gonadotropic hormone, especially the F.S.H. factor, with increased excretion in the urine. This is similar to the condition commonly found in the urine of women past the menopause.

The amount of the gonadotropic hormone in the blood as determined by Frank varies during the menstrual cycle, as is shown in the chart (Fig. 42). The increase to a maximum on the ninth day in the blood and the eleventh day in the urine (Kurzrok) would indicate a stimulation necessary for ovulation. Seidlin found that the gonadotropic hormones are metabolized by the ovary in vivo or in vitro and by no other tissue.

The weight of evidence at present is that there are two gonadotropic hormones of the anterior pituitary group—pituitary A and pituitary B. Shedlovsky and his associates have recently isolated the luteinizing hormone (B) in pure form and the follicle-stimulating hormone (A) in "almost" pure form.

Pituitary A (F.S.H.). This is the follicle-stimulating hormone which causes growth and development of the follicles and incites the granulosa cells and probably the theca interna to secrete estrogen. It does not, in its purest form, cause the follicle to become luteinized. Werner has shown that during the normal menstrual cycle there is a sudden transient increase of pituitary A in the urine at the mid-interval, evidently related to ovulation. In support of this idea Werner found pregnanediol in the urine two to five days following the increase of pituitary A. D'Amour feels that this pituitary A is the same as that which is found in menopause urine.

In the male, pituitary A stimulates the tubular elements of the testes.

Pituitary B (L.H.). This is the luteinizing hormone which acts on follicles, when ripened to a certain degree by pituitary A, and produces lutein changes leading to the secretion of progesterone. It augments the follicle-stimulating action so that the sum of the action of both together is greater than that of either used separately. It causes a rapid involution of existing corpora lutea.

In the male, pituitary B causes growth and functional activity of the interstitial tissue of the testes and stimulates growth of the accessory structures, the latter probably indirectly by its stimulation of androgen secretion.

Chorionic Gonadotropins

The chorionic gonadotropic hormones are of two kinds: (a) those present in the blood and urine of pregnant women and (b) those present in the blood of pregnant mares.

Human Chorionic Hormones. These appear in the blood and urine soon after the implantation of the ovum and the amount rises to a maximum in fifty to sixty days after the last menstrual period, after which there is a rapid fall to a lower level for the remainder of the pregnancy.

These gonadotropins differ from those of the pituitary group in that their ability to cause follicle growth and ovulation and luteinization, in laboratory animals (mice, rats, guinea pigs, rabbits), is dependent on an intact pituitary. They will not cause these changes in hypophysectomized animals unless treatment is given immediately after hypophysectomy while some of the actual pituitary secretion is still present.

The predominating effect of these pregnancy-urine hormones is luteinization in the laboratory animals mentioned. In monkeys and human beings these gonadotropins will not cause follicle growth or ovulation or luteinization even though the pituitary is intact.

The hormones obtained from human pregnancy-urine are similar to the gonadotropins of the anterior pituitary group, but not identical, for the pituitary must be present for them to operate in the laboratory animal experiments. The preponderating effect of these pregnancy-urine hormones is similar to that of pituitary B, whereas the effect of menopause-urine hormones (prolan A) is nearly altogether that of pituitary A.

Pregnant-Mare-Serum Hormones. The second type of chorionic gonadotropic hormones are present in the blood serum (but not in the urine) of pregnant mares. In laboratory animals this serum produces responses similar to those obtained by a combination of human pregnancy-urine and menopause-urine; that is, it produces follicle growth and ovulation and luteinization. In monkeys, which are different from the "laboratory" animals, this serum produces follicle stimulation and ovulation but no luteinization.

In human beings, Davis and Koff were able, in normally ovulating women, to produce ovulation at will by intravenous administration of forty to sixty units. So far it has not been proved to cause this effect in nonovulating women. The fate of the serum hormone after injection is not known, but it is not excreted in the urine. This hormone has been purified, and preparations of high potency are on the market.

OTHER HORMONES

From what has been said it is evident that the ovaries constitute an important coordinating unit in the great endocrine glandular system, all parts of which are interrelated. The ovarian-pituitary cycle will function normally, and thus induce and maintain normal genital development and activity, only so long as this entire system persists in a state of equilibrium effected by "interglandular reciprocity" and "chemical correlation" of all its members. Ovarian function, therefore, is very likely to be interfered with whenever this balance becomes disturbed through either hypofunction or hyperfunction of an individual gland. The glands principally concerned in this connection are the pituitary, thyroid, adrenals, and pancreas.

Pituitary Hormones

In the extensive and complicated endocrine system the pituitary gland exercises a major influence, indicated by the large number of hormones originating in its anterior and posterior portions. In addition to the gonadotropins, already described, the pituitary hormones of special gynecologic interest are the growth, thyrotropic, adrenotropic, lactogenic, and oxytocic.

Growth Hormone.—Long and Evans, in 1922, demonstrated the stimulating effect of the anterior pituitary on growth in normal rats. They succeeded in restoring normal growth in rats dwarfed by hypophysectomy by administration of anterior pituitary gland.

Although preparations of this hormone are not pure physiologically, they may now be freed sufficiently from contaminating hormones to produce normal growth while the thyroid and gonads and adrenal cortex remain atrophic. Evans states that it is probable that all forms of dwarfism are directly caused by inadequate pituitary function, regardless of the ulterior cause. Cretinic

dwarfs are the result of a depression of the pituitary function secondary to a thyroid deficiency. It can be corrected indirectly by administration of thyroid, with the consequent stimulation of the hypophysis, or directly by administration of anterior pituitary extracts of the growth hormone.

Thyrotropic Hormone.—In 1917, B. M. Allen showed that extirpation of the anterior lobe of the pituitary caused atrophy of the thyroid and the adrenals in amphibia. Administration of fresh bovine anterior pituitary in these amphibia caused repair and activation of the involuted thyroid and in some cases even produced hyperplasia.

The discovery of the thyroid-stimulating effect in animals was made by Loeb in 1929 and independently by Aron a little later. P. E. Smith found that the atrophy of the thyroid and adrenals caused by hypophysectomy in mammals could be corrected by replacement therapy. It is now known that these thyroid-stimulating effects are due to a specific hormone of the anterior pituitary, and this has been named by Wiesner and Crew the thyrotropic hormone.

A partial purification was first achieved independently by Junckmann and Schoeller and by Loeser in 1932. The thyrotropic hormone exerts its action only in the presence of the thyroid gland. It is not active by mouth and is destroyed by boiling. The administration of the thyrotropic hormone to normal animals results, in the course of a few days, in enlargement and hyperplasia of the thyroid. There is an increase in heart rate, exophthalmos, reduction in the iodine content of the gland, and a depletion of liver glycogen.

Adrenotropic Hormone.—For years clinicians have recognized that there was a definite relationship between certain adrenal lesions and certain types of precocious menstruation. Also secondary amenorrhea may be associated with adrenal hyperplasia, as emphasized by Cecil and others. Operations to remove the adrenal lesion usually reestablish the normal pelvic function.

As previously mentioned, P. E. Smith demonstrated that the atrophy of the adrenal cortex occurring after hypophysectomy could be prevented by intramuscular transplants of fresh hypophysis. Evans obtained the same results, using purified extracts.

Clinically, destruction of the hypophysis by disease causes atrophy of the adrenal cortex, while in functioning tumors of the pituitary (especially cases of acromegaly) hypertrophy of the adrenal cortex occurs.

Lactogenic Hormone.—The association of the mammary gland with pelvic function has always been evident, from the changes taking place with puberty, menstruation, pregnancy, and the menopause. The mechanism of this relationship was obscure until Stricker and Grueter reported lactation produced by the administration of anterior pituitary extract. Corner confirmed this work in 1930 and more recently the hormone has been studied in detail by Asdell, Nelson and Pfiffner, Gardner and Turner. In 1933, Riddle, Bates, and Dyskshorn published an article on "The Preparation and Assay of Prolactin—a Hormone of the Anterior Pituitary." Prolactin causes the onset and continuation of milk secretion after the breast has first been developed by estrin. Selye showed that a brief period of lactation will occur in hypophysectomized rats at parturition, so the anterior pituitary is probably not the only source of the lactogenic hormone. Werner was unable to cause lactation in castrate women

although the breast was first stimulated by injections of theelin followed by corporin, before the administration of the prolactin. Growth of the male breast and lactation have been accomplished by combined use of theelin and prolactin.

Pancreotropic Hormone.—Insulin is used for the relief of dysmenorrhea, and there may be some relationship between its action in this condition and its effect on the pituitary.

Oxytocic Hormone.—Pituitrin and similar acting preparations are from the posterior lobe of the pituitary. All the other hormones mentioned are from the anterior lobe.

Nongenital Hormones.—There are many hormones of the pituitary which are only indirectly concerned with the genital functions and therefore are not discussed in detail here. The importance of the pituitary in general endocrine control is indicated by the number and variety of its hormones, as shown in the accompanying table by Jores.

TABLE OF PITUITARY HORMONES (BY ARTHUR JORES)

HORMONE	SOURCE	REMARKS	AUTHORS
1. Oxytocic hormone	Posterior lobe	Successfully isolated	Dale, Kamm
2. (a) Blood pressure hormone	Posterior lobe	Identity questionable	
(b) Intestinal hormone	Posterior lobe	Isolation not yet successful	Schäfer, Oliver, Kamm
(c) Antidiuresis hormone	Posterior lobe		
3. Intermedin (Erythrophoric) hormone	Middle lobe	Successfully isolated	B. Zondek and Krohn
4. Melanophoric hormone	Basophile anterior lobe cells	Successfully isolated	Hogben, Winton, Jores
5. Growth hormone	Eosinophile anterior lobe cells	Successfully isolated	Long and Evans
6. Follicle-ripening hormone	Basophile anterior lobe cells	Successfully isolated	
7. Luteinizing hormone	Basophile anterior lobe cells	Identity questionable	Smith, Zondek, Aschheim
8. Thyrotropic hormone	Anterior lobe	Successfully isolated	Aron, Crew and Wiesner
9. Lipoitrin	Anterior and posterior lobes	Successfully isolated	Raab
10. Fat metabolism hormone	Anterior lobe		Anselmino and Hoffmann
11. Pancreotropic hormone	Anterior lobe		Anselmino and Hoffmann
12. Parathyrotropic hormone	Anterior lobe		Anselmino and Hoffmann
13. Adrenotropic hormone	Anterior lobe	Identical with the pigment hormone?	Smith, Anselmino, and Hoffmann
14. Contrainsulin hormone	Anterior lobe	Identical with the growth hormone?	Houssay and Unger, Lucke
15. Lactogenic hormone (Prolactin)	Anterior lobe		Lyons, Riddle

Since this table was published much investigative work has been carried on in various directions. A few items of interest in this field are that lactogenic, thyrotropic and chromatophoric hormones have been isolated from human pituitary glands (by M. Riley) and that purified factors of lactogenic, follicle-stimulating, luteinizing, thyrotropic, and growth-promoting hormones have been obtained (by Fevold, Lee, Milton, Hisaw, and Cohn).

Thyroid Hormone

The influence of thyroid extract on disturbances in pelvic endocrine function has long been known clinically. In fact, it was for many years the one glandular extract which seemed to give any consistent results. The exact mechanism of its action is still not known, but the effects obtained are probably due both to its general action on metabolism and to some action on the anterior pituitary.

Adrenal Cortex Hormone

In normal animals administration of the adrenal cortex hormone caused a slight decrease in the positive potassium balance, and in large doses it caused an increase in the reticulocytes. Removal of either the hypophysis or the adrenal gland leads to atrophy of the ovary. This is repaired by anterior lobe injections in the absence of the adrenals, but not by injections of adrenal cortex hormone in the absence of the pituitary.

This would indicate that the adrenal effect is indirect through the anterior pituitary. Evidence of direct action on the ovary, however, has been presented by Migliavacca. He gave adrenal cortical hormone to guinea pigs in which the pituitary had been inactivated by roentgen radiation, and succeeded in producing luteinization of the ovarian follicle. He concludes that this effect, which is the same as that of pituitary B, is a direct one by the adrenal cortex on the ovary. Hirsutism and virilism cannot be caused by injection of this hormone nor can such injection cause the condition of basophilia of the pituitary. It may be that the secondary changes which result with adrenal cortex lesions are due to another hormone or to a withdrawal of the cortical hormone.

L. R. Broster gives the following classification for the adrenogenital syndrome: Group I, in which there is adrenal pseudohermaphroditism, usually discovered at puberty because of primary amenorrhea; Group II, in which adrenal virilism appears after puberty with secondary amenorrhea; Group III, in which mild virilism, in association with other endocrine disturbances, especially those of the pituitary, occurs after puberty. The patients in the last group usually have excess fat. Excellent results were obtained by adrenalectomy in the Group II cases, but not in Groups I and III.

There is no satisfactory physiologic test for the hormone.

ANTIHORMONES

Other possible factors called antihormones should be mentioned before leaving the hormones. These are substances of unknown origin which appear in the serum of animals treated over long periods of time with anterior pituitary extracts. These substances seem to make the animal less responsive to the extracts, and the serum of animals which have been treated if injected into untreated animals makes the latter animals refractory to treatment with similar extracts. These antigonadotropic sera when administered to untreated animals prevent the action of endogenous gonadotropic hormones and have effects similar to hypophysectomy.

To account for these effects, Collip advanced the theory of antihormones. According to this theory the level of a hormone in the body is related directly to the level of the corresponding antihormone.

PUBERTY AND CLIMACTERIC

The development of the ovarian functioning elements has been described and illustrated. General physical growth takes place along with this ovarian growth, and when development is sufficiently completed ovulation begins. This is signalled in a general way by the beginning of menstruation. The latter part of the period of growth and the establishment of ovulation and menstruation is designated **puberty**. This is a general term used conveniently to cover the whole developmental picture at this age. The term **menarche** is used to indicate particularly the beginning of menstruation, which is considered further under Physiology of the Uterus.

After the allotted period for childbearing, the ovarian function declines. The decline is gradual, extending over some years like the development, and this time of readjustment is designated the **climacteric**. When the adjustment is sufficiently completed the menstrual flow ceases. The term **menopause** refers particularly to the cessation of menstruation, and is considered further under the Physiology of the Uterus.

The years of puberty and of the climacteric, being periods of adjustment to new conditions, are accompanied with some special stresses, an outward evidence of which is a certain instability of nervous reactions. Though usually not serious, various climacteric disturbances may be quite uncomfortable. The development of endocrine knowledge, however, and its application to therapy have reduced materially the discomforts of this readjustment period. The diagnosis and treatment of these manifestations are considered under Disturbance of Function (Chapter XVI).

THE PAROVARIUM

The parovarium is the remains of a fetal organ, the wolffian body, which helps to form the generative organs. It consists of a triangular group of tubules situated in that part of the broad ligament lying between the ovary and the fallopian tube. The apex of the triangle lies near the hilum of the ovary. Beginning near the hilum of the ovary, the tubules extend upward, almost parallel, or in a kind of fan-shaped formation, and enter a transverse tube. This transverse tube is called the "head tube," and it terminates in a small cul-de-sac near the fimbriated extremity of the fallopian tube (Figs. 48, 49). Very often this little cul-de-sac becomes distended with fluid and forms a miniature cyst on the surface of the broad ligament. But the little cyst thus formed is apparently distinct from another miniature cyst usually found in the same vicinity and called the "hydatid of Morgagni." The hydatid of Morgagni is the dilated end of another fetal structure—the duct of Müller, which forms the fallopian tube.

Another smaller group of remnants of the wolffian body which lies nearer the uterus is called the "paroophoron" (Figs. 48 and 49).
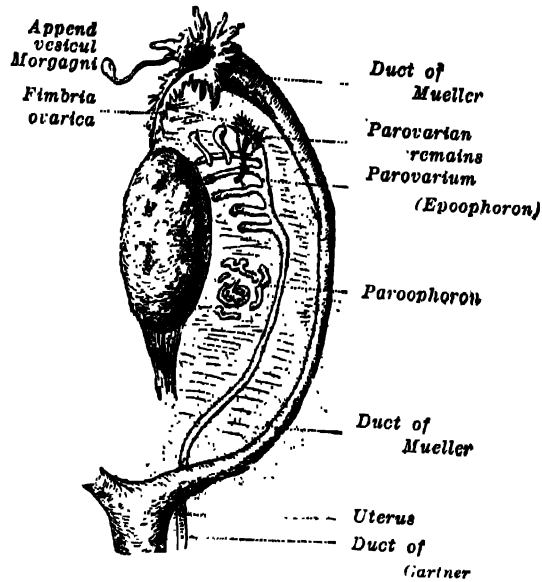
Fig. 48.—Embryonic genital organs, showing the parovarium and paroophoron, and their relation to the tube and ovary and duct of Gärtner. (Abel, after Kollman—*Gynecological Pathology*, William Wood & Company.)
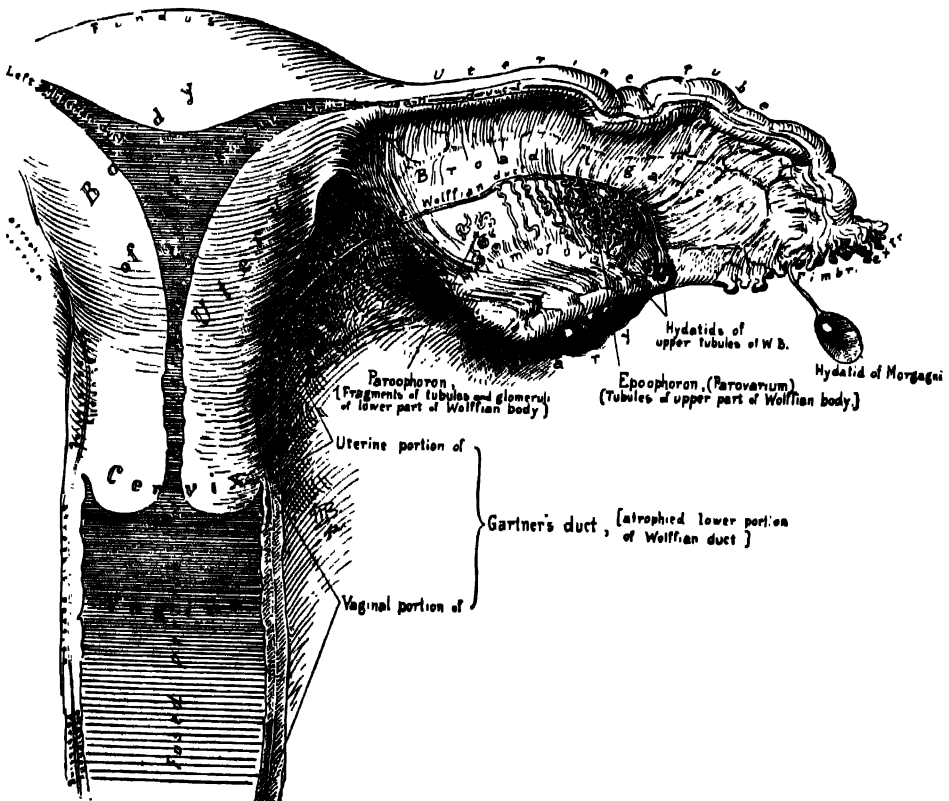
Fig. 49.—Adult genital organs showing parovarium, Gärtner's duct and various other structures. (Kelly, after Cullen—*Operative Gynecology*, D. Appleton-Century Company.)

The tubules of the parovarium and paroophoron are embedded in the delicate connective tissue between the layers of the broad ligament and have no connection with any of the surrounding organs.

The structure has no function, and it is of interest chiefly because it gives rise to certain tumors of the broad ligament.

UTERUS

The uterus is the organ which receives the fertilized ovum, provides for its embedding and nourishment, sustains and protects it through the various stages of growth, and expels the developed child at term. While secondary to the ovaries in the general scheme of reproduction, it is in its own right a remarkable organ. It is unique in its capacity for enormous enlargement to meet the needs of the growing fetus. Hardly less remarkable is its prompt return to nearly its former small size. Remarkable also is its strange lining mucosa, the endometrium, which disintegrates and is renewed at approximately monthly intervals over a period of thirty years.

Almost as striking as the phenomena themselves is the fact that, though recurring the world over, for thousands of years, it is only within the last few decades that there has been any rational explanation of how the controlling factors worked, or even what those factors were. The wonderful revelations in this respect serve as indications of the new worlds of knowledge opened by the splendid clinical and laboratory investigations of modern medicine.

ANATOMY

The surroundings and general relations of the uterus are shown in Figs. 2 to 6. It is situated about the center of the pelvic cavity, between the bladder and the rectum, and projects upward into the lower part of the peritoneal cavity, and its convex surface, except the lower portion, is enveloped by peritoneum. The upper end of the uterus is directed forward. The lower end is directed backward and downward and projects into the upper end of the vagina. The uterus is freely movable, especially the upper portion, and may be pushed backward by a full bladder or forward by a full rectum.

The uterus is shaped somewhat like an inverted pear (Fig. 50). Its lower constricted portion is called the cervix uteri (neck of the uterus) and to this the vagina is attached. The remainder of the organ is called the corpus uteri (body of the uterus). It is from the upper portion of the uterus, the widest portion, that the fallopian tubes arise. That portion of the uterus lying above the fallopian tubes is known as the fundus uteri (Fig. 51).

The uterus has a small central cavity (Figs. 50 to 52) which is lined with mucous membrane and which communicates through the vagina with the outside world and through the fallopian tubes with the peritoneal cavity. This is the only continuous opening from the outside of the body into the peritoneal sac, and it is because of this direct opening into the peritoneal cavity that peritonitis is so much more frequent in women than in men.

The size of the uterus is, of course, different in the different periods of life (Figs. 53 to 55). At birth it is a trifle over one inch long and the cervix

comprises two-thirds of the organ (Fig 53). It is important to keep in mind the peculiarities of the infantile uterus, for occasionally an adult presents a uterus somewhat infantile and accompanied with troublesome symptoms due to lack of development. A rather common condition and a very troublesome one (see dysmenorrhea) is a sharp anteflexion of the cervix, the corpus uteri being in practically normal position, but the cervix being flexed sharply for-
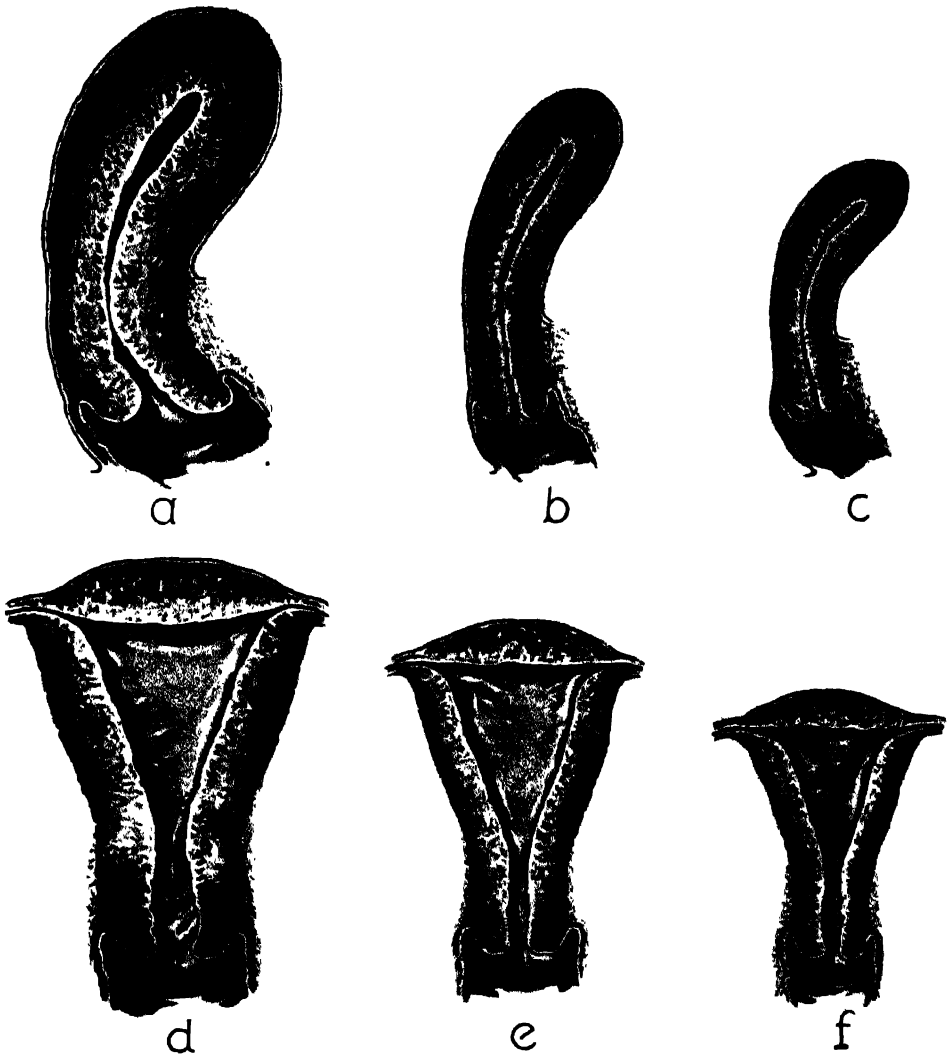
Fig. 50.—Drawings made directly from autopsy specimens. a, anteroposterior section of uterus from an individual, aged twenty-three years; b, aged fifty years; c, aged seventy years; d, e, f, transverse sections of the same uteri: d, aged twenty-three years; e, aged fifty years; f, aged seventy years.

ward and directed along the vaginal canal toward the opening. In the fetus, the uterus lies very high and the cervix is very long. At first the axis of the cervix lies almost in the axis of the vagina. Normally, as development progresses, the corpus uteri gradually comes forward, and the cervix becomes directed somewhat backward, across the vaginal axis. In the cases of imperfect development already referred to, the corpus uteri comes forward normally

but the cervix fails to assume its backward direction, remaining in practically the fetal position (directed along the axis of the vagina) and causing a sharp "anteflexion of the cervix."
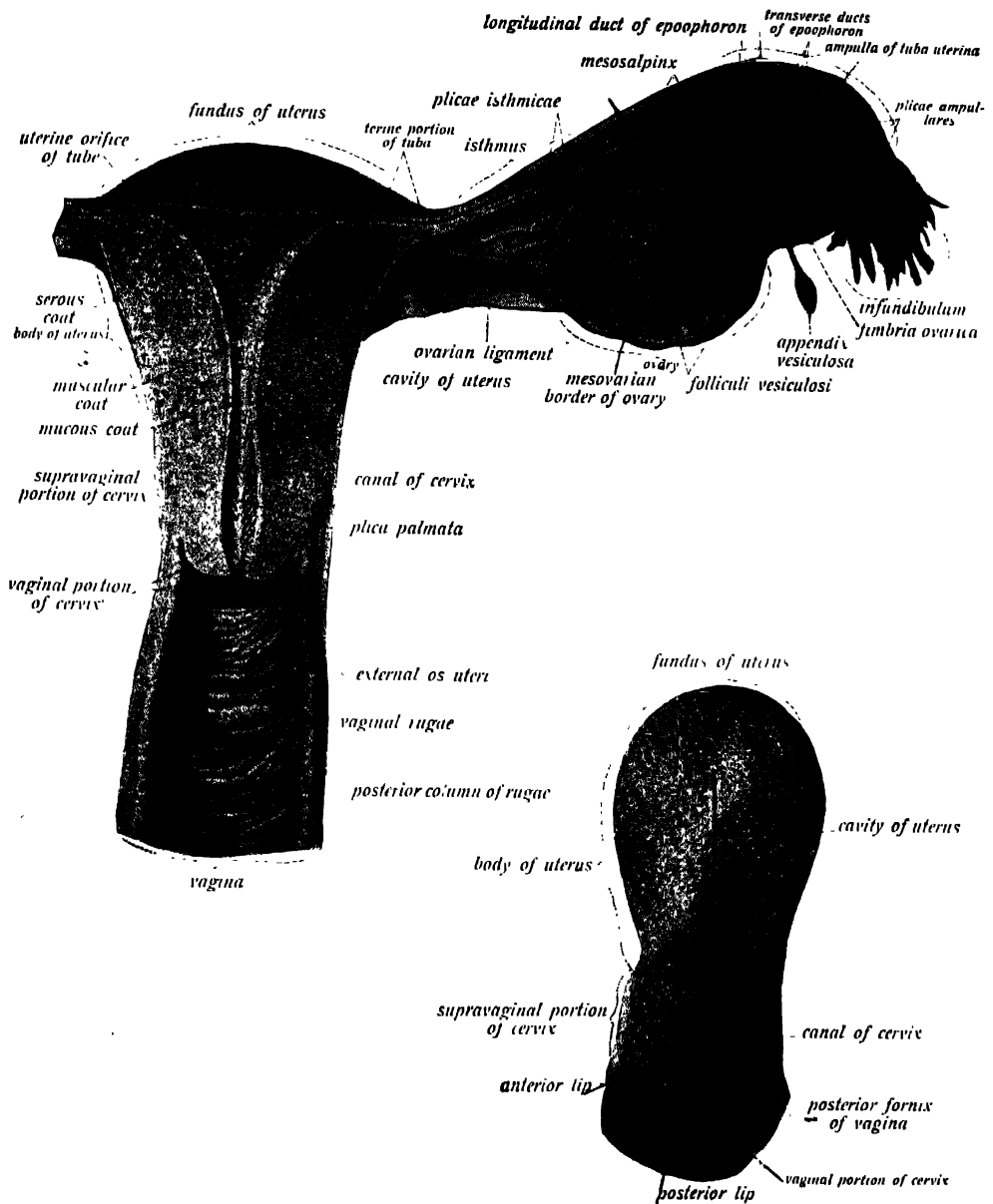
Fig. 51.—The uterus and the right fallopian tube and the right ovary, laid open. View from behind. In the right lower corner, an anteroposterior section of the uterus is shown. (Sobotta and McMurrich—*Human Anatomy*, G. E. Stechert & Company.)

The principal significance of this condition, when found in examination, is the indication that the uterus is underdeveloped—not only in the relation of the cervix to the corpus, which is of minor importance, but in its nervous and nutritional stability, which may have much to do with pain and endometrial functioning and hence must be considered in dysmenorrhea and in

sterility. Occasionally there is an associated narrowing of the canal, interfering with easy escape of menstrual blood and clots and increasing the uterine hypersensitiveness and contractility.

As to the approximate measurements, the **adult virgin** uterus is three inches long (cavity two and one-half inches) and the cervix forms one-third of the organ. The transverse measurement at the widest part is one and a half to two inches, and the average thickness is one inch. It weighs from an ounce and a half to two ounces. After **childbirth** the uterus is always a little larger
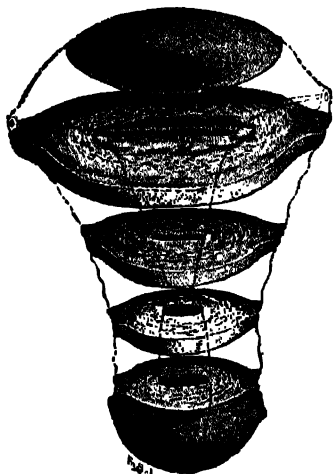
Fig. 53.
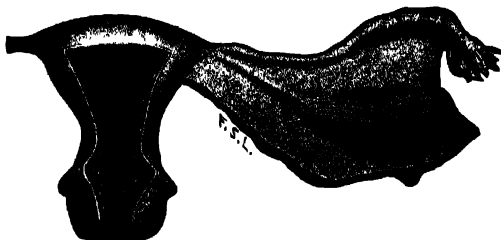
Fig. 52.

Fig. 54.

Fig. 55.

Fig. 52.—Reconstruction of the uterus, showing the shape of the cavity. (Williams—*Obstetrics*, D. Appleton-Century Company.)

Fig. 53.—Uterus and appendages of a young child. (Williams—*Obstetrics*.)

Fig. 54.—Uterus and tube and ovary of a fourteen-year-old girl. (Williams—*Obstetrics*.)

Fig. 55.—Uterus and tube and ovary of a twenty-year-old multipara. (Williams—*Obstetrics*.)

than the virgin uterus. The parous uterus is of course the kind most frequently requiring examination. The cavity measures from two and one-half to three inches. After the **menopause** there is marked atrophy of all the genital organs, including the uterus (Fig. 56). The extent of the atrophy of the uterus is variable. In the very aged it may be reduced to a nodule the size of the end of the thumb, and the cervix then no longer projects into the vaginal

cavity, but is felt simply as an indurated area, with a small central opening, situated in the upper part of the anterior vaginal wall.

In structure the uterus is a hollow muscle. The central cavity is lined with mucous membrane while the external surface of the muscle is covered with peritoneum. The wall of the uterus is, therefore, composed of three layers—peritoneal, muscular, and mucous (Figs. 50, 57).

1. **Peritoneal Layer.**—This forms a delicate serous covering to the uterus. It does not differ materially from peritoneum elsewhere. There are certain portions of the uterus which are not covered by peritoneum, namely, the lateral portions of the body and the front and sides of the cervix.

2. **Muscular Layer.**—This is the real wall of the uterus. It is from 11 to 15 mm. thick and is composed of involuntary muscular tissue. Under the microscope, the principal elements are seen to be the long muscle cells. They are fusiform in shape and are arranged in parallel rows. These rows of muscle cells are arranged in bundles that extend in various directions.

The muscular wall of the uterus is divided somewhat into **strata**. In the unimpregnated uterus, the different strata are not clearly defined, but, speaking in a general way, it may be said that the muscular bundles are arranged in three strata—a thin outer longitudinal stratum, a thick middle stratum of interlocking bundles extending largely in a circular direction, and a thin inner stratum with fibers extending in various directions.

The **connective tissue** of the muscular layer comprises most of the connective tissue of the utreus. It is not distributed in the form of distinct strata, but appears as irregular masses surrounding and supporting the important elements. There is a very intimate connection between the mucous membrane lining the uterus and the connective tissue of the muscular layer.

The **blood vessels** of the muscular wall include most of the blood vessels of the uterus, and they are particularly large and numerous in the middle layer.

The arteries are distinguished in a microscopic section by their thick walls and folded intima. The outer vessels run in a longitudinal direction, while the inner vessels run perpendicular to the mucous surface. There is a dense capillary network close to the mucous membrane.

The veins are very large and have thin walls.

The **lymphatics** of all the coats of the uterus (peritoneal, muscular, and mucous) empty into large lymphatic vessels in the external muscular stratum. These in turn empty into efferent trunks at the sides of the uterus.

The **nerves** of the muscular layer are derived from the autonomic system. The filaments ramify among the muscular bundles and terminate in the nuclei of the muscle cells.

3. **Mucous Layer.**—The mucous membrane of the uterus lies directly on the internal muscular stratum, the usual submucous layer of loose connective tissue being absent (Figs. 57, 58). Scattered muscular filaments extend into the mucosa, so the connection between the two is firm. The mucous membrane of the body of the uterus is known as the "endometrium," that lining the cervix is known as the "cervical mucosa."

The **endometrium** is from 2 to 6 mm. thick in the childbearing period, and is disposed over the interior of the uterus as a smooth layer (Fig. 57). It is

soft and velvety to the touch, and when perfectly fresh has a pink color. There is a great difference in the thickness and general appearance of the endometrium in the different periods of life and also in the different stages of the menstrual cycle. The cyclic changes of the endometrium associated with menstruation are discussed and illustrated in detail under Physiology of the Uterus.

The interglandular supporting tissue of the endometrium is composed almost exclusively of oval cells, somewhat larger than a leucocyte and having a round or oval nucleus that stains lightly (Fig. 59). The nucleus is so large that it occupies most of the cell. When stained it is reticular, i.e., it shows the chromatin bands and does not stain a solid dark color as does the nucleus of a lymphocyte. These oval cells with the large reticular nuclei are known as **stroma cells** (Fig. 54). They are packed closely together, with nothing separating them except a few cell processes and a small amount of serous or
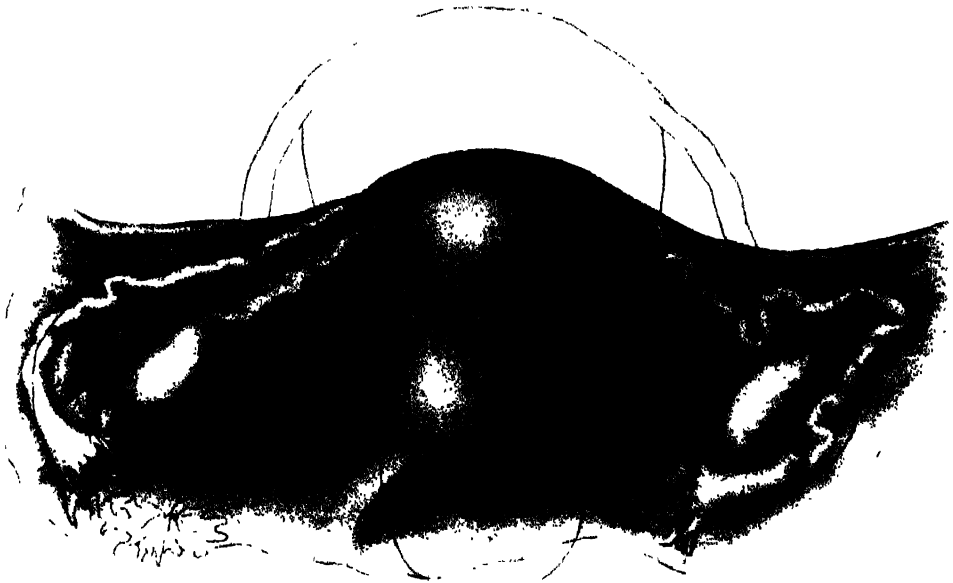
Fig. 56.—Drawing directly from an autopsy specimen of the ovaries, tubes, and uterus at seventy years of age. The shrinkage from age is very marked, but is so uniform that the relative size of the organs is maintained. The tubes have diminished more in thickness than in length.

The marked senile shrinkage is indicated by the superimposed twenty-three-year-old organs, in red outline.

mucoid intercellular substance. The tissue thus formed is known as **cytogenic tissue.** When a specimen of it is stained, the microscopic field seems to be almost entirely occupied by rounded or oval reticular nuclei (Fig 59). The cell protoplasm stains so lightly and is so small in amount that it is scarcely noticeable. The stroma probably represents embryonic connective tissue. In the resting endometrium the stromal cells are closely packed and stain very deeply. Under certain conditions, however, they become swollen and stain more lightly. This occurs in the premenstrual stage and, especially, during pregnancy. In the latter case, they greatly enlarge and become the **decidua cells.** Under these conditions, also, the intercellular serous or mucoid material becomes noticeable, thus giving the whole an edematous appearance.

The stroma is rich in capillaries which become much increased in size and number in the premenstrual stage. They arise in the basal layer and course upward, forming right-angled loops near the surface.

Embedded in the stroma are the **uterine glands** (Figs. 58, 59). These are lined by a single layer of epithelial cells, the nucleus of each cell being placed near its center. In the stage of secretion, they crowd each other, forming a very irregular line, unlike the regular arrangement of the nuclei in the cervical glands. The glands extend from the depth of the endometrium and open upon the surface. They vary considerably in different parts of their course, especially in the premenstrual stage.

These cyclic changes of the endometrium are discussed under Physiology of the Uterus.
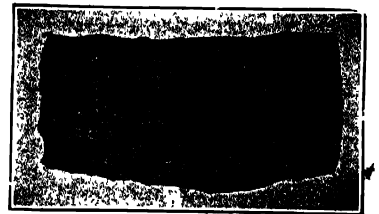
Fig. 57.—*A*, A normal uterus divided from in front, showing the smoothness of the endometrium and also its relative thickness. (Cullen—*Cancer of the Uterus*, W. B. Saunders.)

B, Photograph of normal uterine wall magnified approximately two times, showing the relative thickness of the endometrium (at left end) and of the myometrium. Gyn. Lab.

Peculiarities of the Cervix Uteri

The structure of the cervix differs from that of the body of the uterus in several particulars, as follows:

a. The greater part of the cervix has no peritoneal covering (Fig. 60).

b. The muscular layer of the cervix has a much larger proportion of connective tissue and hence is much firmer.

c. There are no large venous sinuses in the cervix and the blood vessels have thicker walls and smaller lumina than those of the body of the uterus.

d. The mucous membrane lining the cervix (cervical mucosa) is disposed in prominent folds (Figs. 50, 51). These folds extend more or less obliquely outward from two ridges, one situated near the center of the posterior lip and the other near the center of the anterior lip.

e. The glands of the cervix approach the racemose variety. They consist of branching ducts with dilated ends (Figs. 61, 62). The glands are lined with columnar epithelial cells which are even taller than those on the surface. The nucleus of each cell lies at the base. These cells secrete mucus which does not

Fig. 58.—Normal endometrium, midgrowth stage. The stroma is quite compact and the glands are seen as simple tubular glands. They are not so simple, however, as appears on one cross-section. Modeling of the glands from serial sections demonstrates their frequent branching. Gyn. Lab.
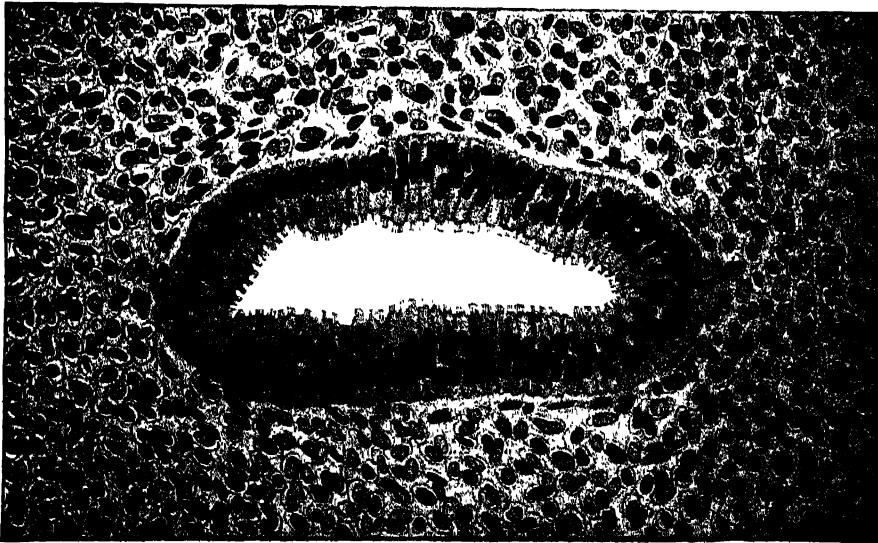
Fig. 59.—A microscopic section of the endometrium, showing the stroma cells and also a cross-section of a gland. The structures are magnified 420 times. (Williams—*Obstetrics.*)

stain appreciably in ordinary preparations (hematoxylin and eosin); consequently that portion of the cell lying next to the lumen, which part of the cell is usually filled with mucus, appears clear (Fig. 62).

The glands of the cervix secrete a clear, viscid, tenacious mucus that fills the cervical canal and serves to close it and prevent invasion of the uterine cavity. The ducts of these glands sometimes become obstructed, causing retention cysts. These are sometimes called "ovulae Nabothi." There may be many of them, in which case the cervix is said to be in a state of "cystic degeneration."

f. The layer of cytogenic tissue with characteristic stroma cells is comparatively thin in the cervix.

g. The cervical mucosa does not undergo the marked menstrual changes of the endometrium. There are, however, some cyclic changes in the cervical epithelium, as shown in Fig. 1 (colored Frontispiece) and described later under Physiology of the Uterus. During pregnancy there is marked proliferation of the mucosa. It also undergoes atrophy of senility, but the change is not so marked as in the endometrium.

h. The vaginal portion of the cervix is covered with squamous epithelium. As can be seen from the photomicrograph (Fig. 63), the squamous epithelium covering the cervix is divided into three layers: the basal layer, the intraepithelial horny layer, and the functional or superficial layer.

The portion of the uterus just above the cervix is called the "isthmus." It is an indefinitely outlined area, the mucosa of which shades from the endometrial to the cervical type, in structure and function. The mucosa of this area takes little part in the menstrual cyclic changes. This is well shown in Fig. 86, which is from a uterus removed just before menstruation. Though ordinarily little noticed, this area of the uterine wall becomes more distinct and of greater significance in obstetrics. Martius has emphasized the importance of the isthmus of the uterus.

Ligaments of the Uterus

The uterus is held in its position by the pelvic floor and by certain ligaments (Fig. 64). They are the broad ligaments, the round ligaments, the sacro-uterine ligaments and the vesico-uterine ligament.

The **vesico-uterine ligament** is simply a fold of peritoneum extending from the uterus to the bladder.

The **sacro-uterine ligaments** are folds of peritoneum extending from the uterus around the rectum to the sacrum (Fig. 64). They contain also fibrous tissue and muscular fibers, hence they are stronger.

The **round ligament** of each side is a fibromuscular cord which arises from the top of the uterus just in front of the fallopian tube and extends outward and forward in the upper part of the broad ligament to the internal inguinal ring (Fig. 64). It then passes through the inguinal canal, and at the external ring divides into fibrous filaments which are lost in the tissues covering the pubic joint. The round ligaments are four or five inches in length and tend to prevent marked backward displacement of the uterus. Ordinarily they are lax but when the uterus is displaced backward by a full bladder or other condition, they are made tense and help to bring the uterus back to its accustomed position. It is the round ligaments that are shortened in certain operations for the cure of backward displacement of the uterus.

The **broad ligament** of each side extends from the lateral portion of the uterus to the pelvic wall (Fig. 64). The attachment to the uterus extends all along the side of the organ from the cervix to the fundus, and there is a correspondingly wide attachment to the pelvic wall. This gives a broad band of tissue (hence the name "broad" ligament) extending from the lateral margins of the uterus to the pelvic wall and holding the uterus in its appointed position in the center of the pelvic cavity (Fig. 64). Each broad ligament is composed of two layers of peritoneum (Fig 65), and between them are a number of important structures. This disposition of the peritoneum and consequent formation of the broad ligaments is represented very well by a thin cloth laid over the pelvis and then tucked down snugly around the pelvic organs. The peritoneum covering the anterior surface of the uterus, when continued laterally, forms the anterior layer of the broad ligament, and that covering the posterior surface of the uterus, continued laterally, forms the posterior layer of the broad ligament. Between these two layers of peritoneum is a considerable amount of connective tissue, especially at the lower part
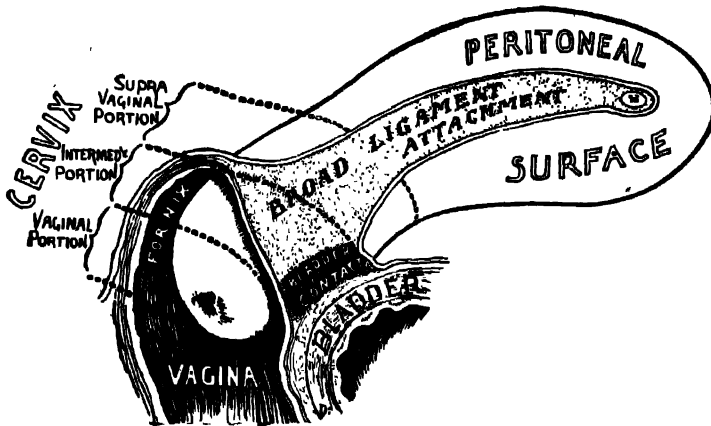
Fig. 60.—Showing the relations of the uterus to the vagina and bladder and peritoneum. (Dickinson—*American Textbook of Obstetrics.*)

(Fig. 65). This connective tissue area around the uterus is known as the "parametrium," and inflammation there is spoken of as "parametritis." Between the peritoneal layers of the broad ligament are the following important structures: fallopian tube, parovarium, ovarian vessels (Fig. 66) round ligament, uterine vessels (Fig. 66), and ureter. The ureter, in its course to the bladder, lies in the lower part of the broad ligament near the cervix and just under the uterine artery, as shown in Fig. 66.

Blood Vessels

The blood supply of the uterus comes from the uterine and ovarian arteries. The **uterine artery** of each side arises from the anterior trunk of the internal iliac (Fig. 66) and passes inward and downward between the layers of the broad ligament to just above the lateral vaginal fornix. It then turns upward and runs in a very tortuous course along the side of the uterus. Near the top of the uterus it joins the descending branch of the ovarian artery, as shown in Fig. 66.

As it runs along the side of the uterus, the uterine artery gives off many branches which run horizontally about the organ and supply various segments. These anastomose with corresponding branches of the opposite artery. These branches are very tortuous, the tortuous and spiral arrangement being so marked that they have been called the "curling arteries" of the uterus. A horizontal branch of considerable size at the level of the internal os is known as the "circular artery."
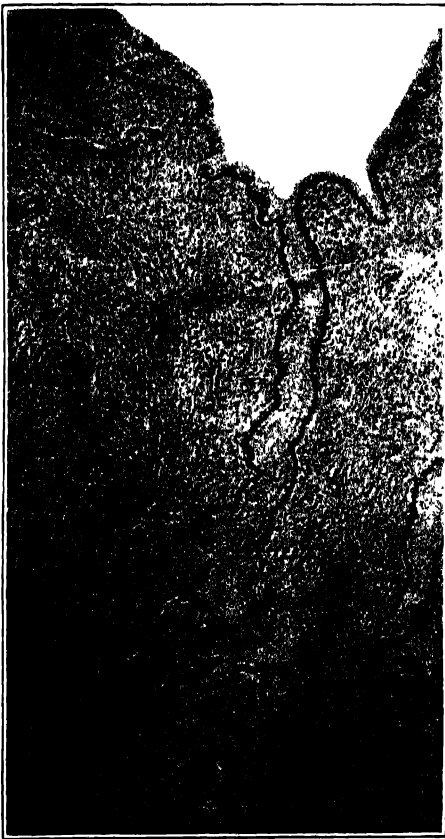
Fig. 61.

Fig. 62.

Fig. 61.—A typical cervical gland is seen in center of picture, with its long neck connecting it with the cervical canal. Gyn. Lab.

Fig. 62.—Cross-section through a practically normal cervical gland. The branched character of the glands is well shown in this and the preceding photomicrograph, also the high cell with the nucleus placed definitely at the base. Gyn. Lab.

The **ovarian artery** of each side supplies the tube, and ovary, and upper part of the uterus as shown in Fig. 66. They correspond to the spermatic arteries in the male and arise directly from the aorta. The artery of each side passes downward and enters the broad ligament. After giving off the branches that supply the ovary, the artery passes on to the upper part of the uterus where it divides into two branches. The upper branch supplies the fundus uteri and anastomoses with the corresponding branch of the opposite artery. The lower and larger branch descends along the side of the uterus and anastomoses with the uterine artery. Some authorities describe the uterine artery as supplying

all the side of the uterus and a part of the tube, and anastomosing with the ovarian artery some distance out along the tube. Possibly the distribution differs considerably in different individuals.

The **veins** of the uterus are exceedingly numerous. The organ is surrounded by a vast network of these vessels, which receive the blood from the veins and sinuses within its walls. There is free communication of this plexus with the vaginal and vesical plexus below and with the ovarian (pampiniform) plexus above, the blood ultimately emptying into the internal iliac vein.
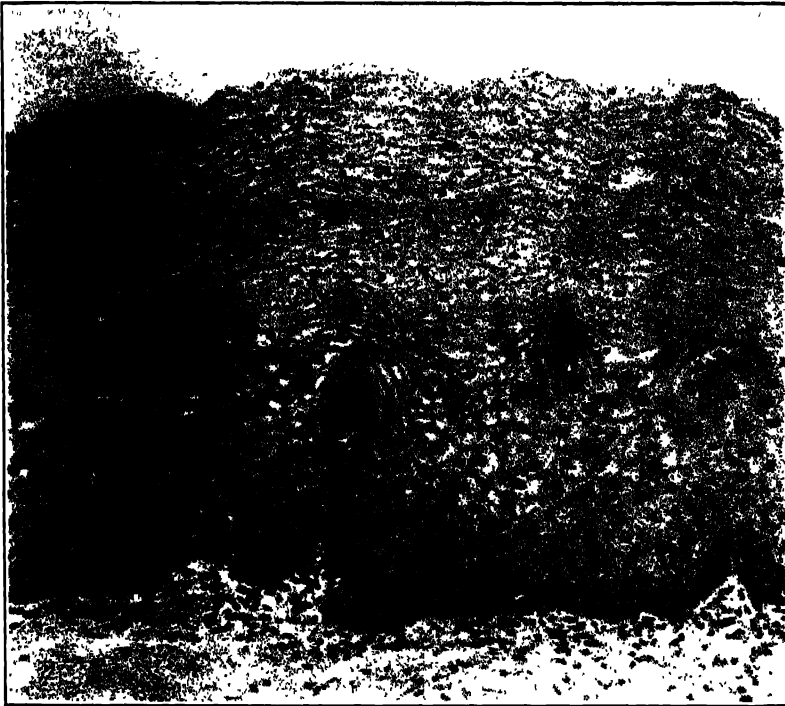
Fig. 63.—Epithelial covering of cervix uteri. Note the three layers: the superficial layer of flat epithelial cells with small nuclei and indistinct cell margins, the middle layer of cuboidal cells, with larger nuclei and fairly distinct cell outline, and the basal layer of high cuboidal cells with basal nuclei. This latter layer takes a much darker stain than do the other two. Gyn. Lab.

Lymphatics

The distribution of the uterine lymphatics to the various gland groups is shown in Fig. 67. The lymphatics constitute the drainage system of the pelvis, by which are carried away those waste products of tissue activity and maintenance which the blood stream cannot handle. The blood-vascular system for carrying needed supplies to the tissues and waste products from them and the nervous system for carrying coordinating messages back and forth have largely monopolized attention as far as carrier service is concerned, but the lymphatic system has a necessary and very important function. The fact that we hear so little about disturbances in this extensive plumbing system is evidence of its efficient working in spite of the wear and tear of daily functional stresses and accidents.
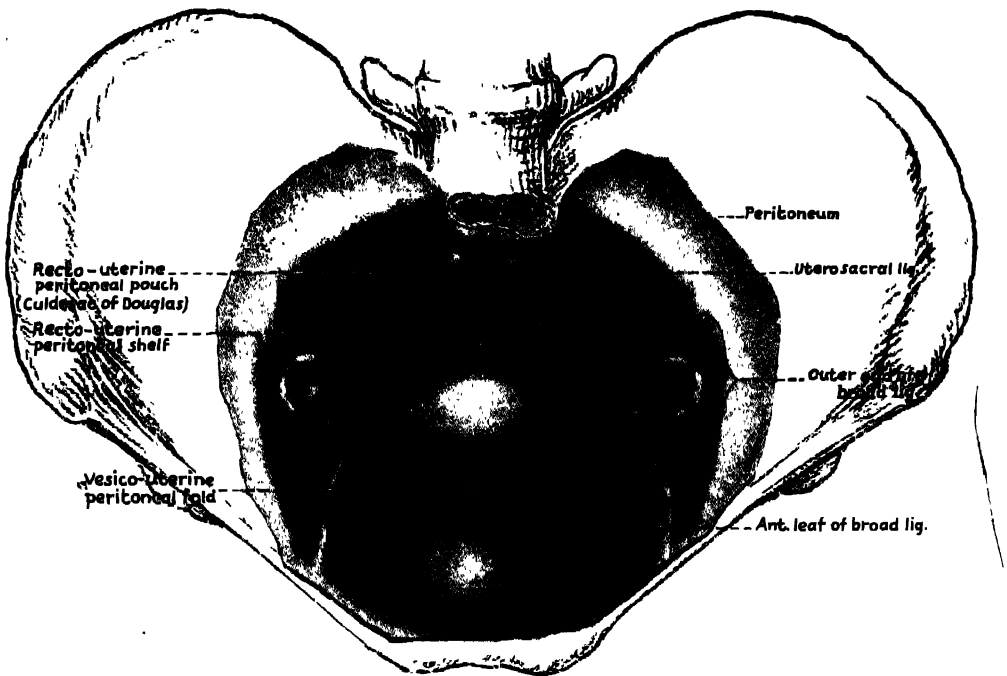
Fig. 64.—Showing the distribution of the peritoneum within the pelvis, and the various ligaments and pouches thus formed. It is as though a thin cloth were laid over the pelvis and then tucked in around all the organs and their wall connections.
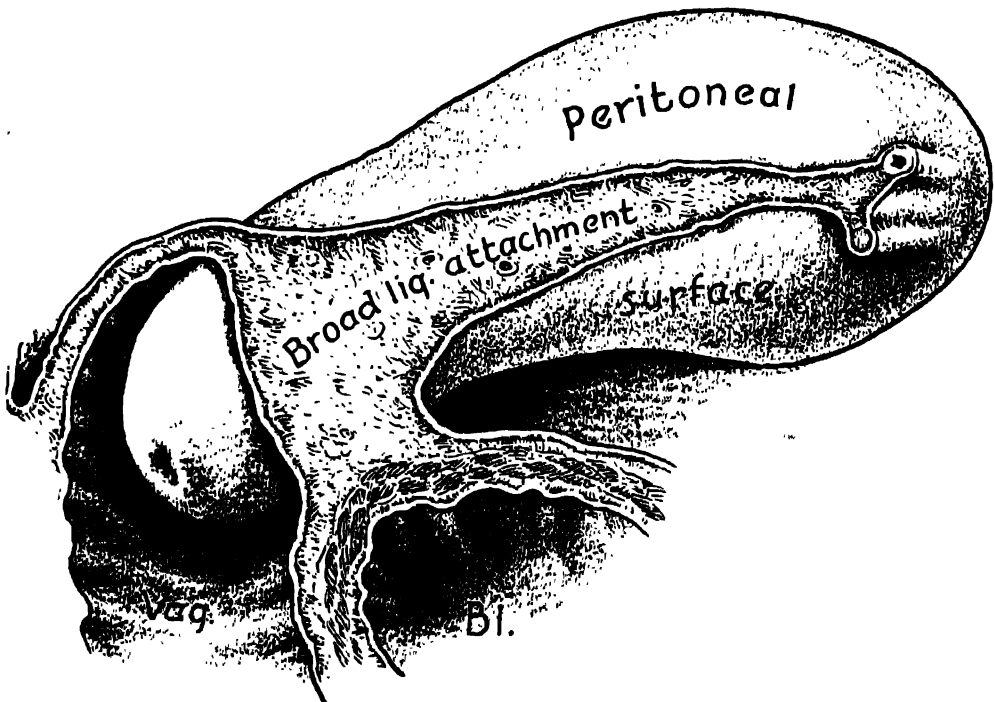
Fig. 65.—This diagrammatic anteroposterior section to the right of the median line shows the broad-ligament attachment to the uterus, and also the relations of the peritoneum anterior and posterior to the uterus. (Modified from Dickinson—*American Textbook of Obstetrics.*)
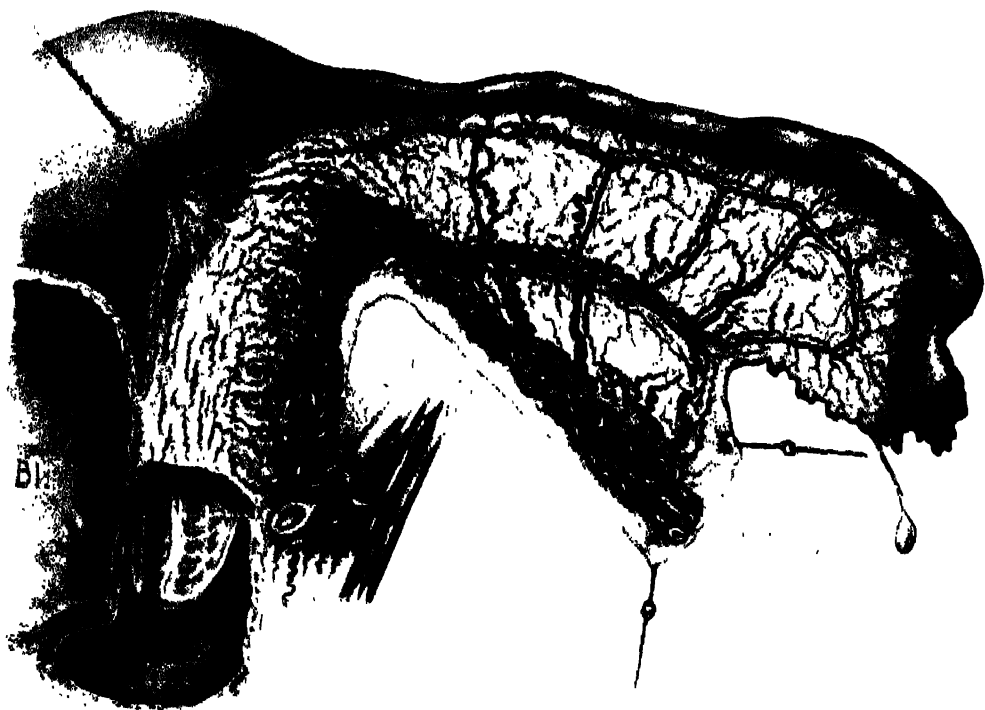
FIG. 66.— THE BLOOD SUPPLY OF THE UTERUS, TUBE, AND OVARY.

View from the front, with left half of bladder removed, showing the relation of the ureter to the uterine vessels. (After Kelly—*Operative Gynecology*, D. Appleton-Century Company.)
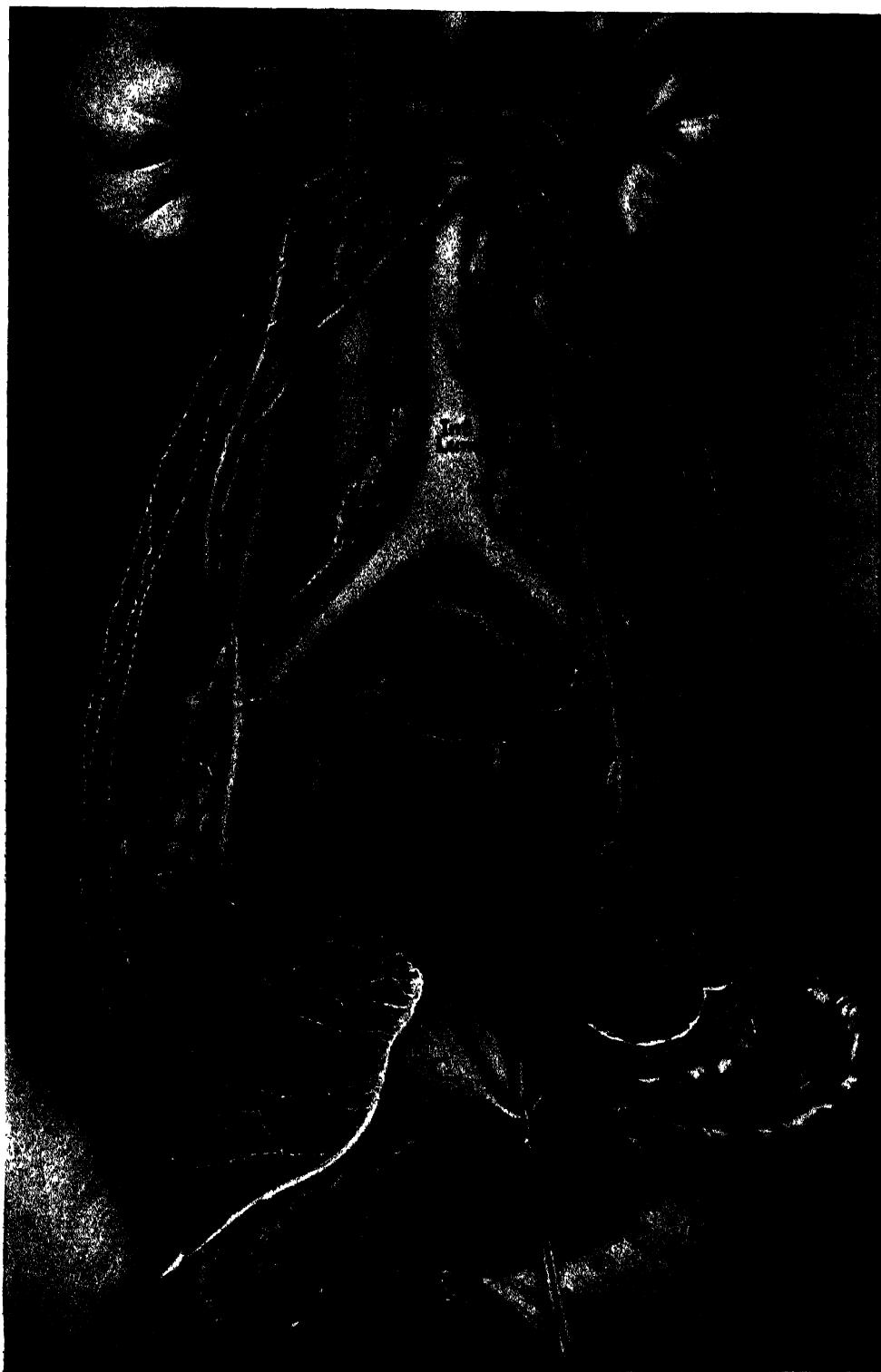
Fig. 67.—The Distribution of the Lymphatics of the Uterus to the Various Groups of Glands. (After Doederlein and Kroenig—*Operative Gynaekologie*.)
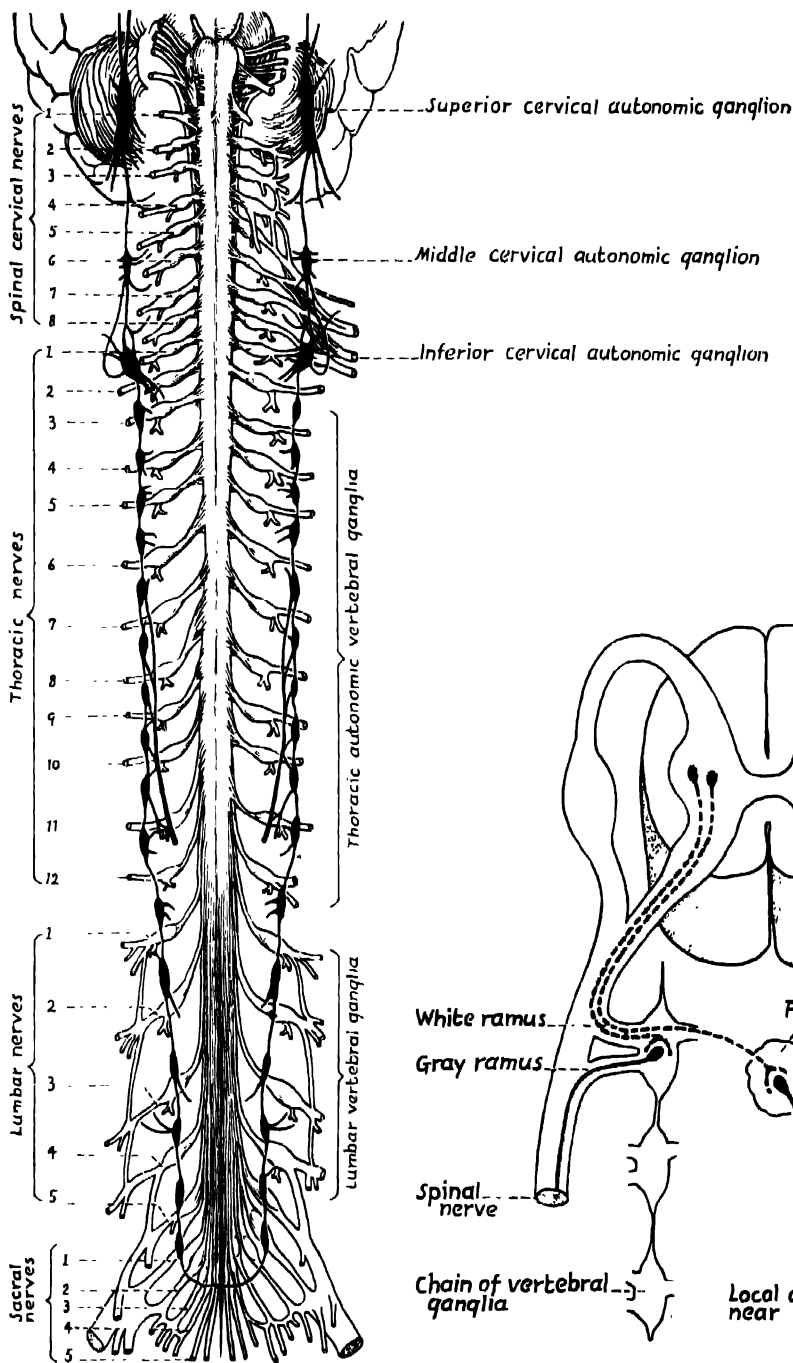
Fig. 68.
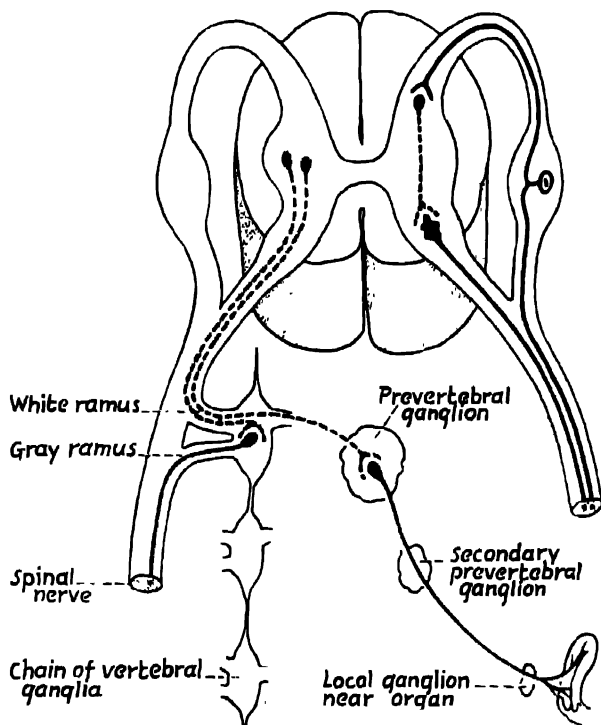
Fig. 69.

Fig. 68.—The nerve supply of the pelvic organs. The vertebral ganglia of the autonomic nervous system. (Modified from Jackson-Morris—*Human Anatomy*.)

Fig. 69.—Contrasting the autonomic reflex arc (in yellow and red) with the **ordinary** spinal nerve reflex arc (in black). (Modified from Best and Taylor—*Physiological Basis of Medical Practice*, Williams and Wilkins.)

Vertebral
ganglia

Prevertebral
ganglia

Local
ganglia

Mesencephalon

Medulla ─ ─ ─ ─

Cervical cord ─ ─

Eye

Salivary
glands

Vasomotor and
cranial mucous
membranes

Heart

Bronchi

Thoracic

1
2
3
4
5
6
7
8
9
10
11
12

To cutaneous vessels
and sweat glands

Coeliac G.

Stomach

Liver

Pancreas

Intestine

Adrenal

Kidney

Lumbar

1
2
3
4
5

Sup.
Mesen.
G.

Inf Mesen G

Sacral ─ ─

Sup. hypogastric
plexus ─ ─ ─

Colon

Bladder

Uterus and
Vagina

Inf hypogastric plexus
Uterovaginal plexus (cervical ganglion)

FIG. 70.—THE NERVE SUPPLY OF THE PELVIC ORGANS.

Diagrammatic representation of the autonomic nervous system, with the sympathetic nerves in red and the parasympathetic nerves in blue. The preganglionic fibers of each are dotted lines and the postganglionic fibers are solid lines. (Modified from Kuntz, after Meyer and Gottlieb, in *The Autonomic Nervous System*, Lea and Febiger.)

Considerable pride has been expressed, and justly so, in the perfection of modern plumbing in this country. The efficiency secured and the study and ingenuity displayed in overcoming the difficulties of installation and maintenance in modern homes and about the working parts of complicated machines are worthy of attention. It is interesting to study the pelvic drainage system from this viewpoint—to consider the various kinds of substances to be removed and the facilities for accomplishing that removal satisfactorily in spite of difficulties due to the smallness of the working parts of the human machine and to the physical and chemical and electrical reactions which must continue undisturbed.

The fine radicles of the lymphatic drainage system start as intercellular spaces among the functioning cells of the uterine muscle and mucosa and connective tissue. The waste-laden fluid, giving up its carbon dioxide and certain other constituents to the venous capillaries on the way out, passes into small thin-lined lymphatics. These combine to form larger vessels which pass through the uterine wall, joining with others on the way to form vessels of increasing size. These join with neighboring vessels to form larger ones and these with others until finally there is formed the main lymphatic trunk, the thoracic duct. A peculiar characteristic of this drainage system is that the collected material is not cast out of the economy directly but is emptied into the blood stream (through the left subclavian vein) to be worked over again before being cast out through the various excretory organs. Thus intake is economized by repeated extraction of elements that can be utilized in the body mechanism.

In certain places along the lymphatic vessels there are nodes or glands which serve as catch-stations to stop the progress of particles, such as bacteria and cancer cells, where phagocytes may destroy them. The phagocytes, however, are not always able to destroy these invaders, which then infiltrate the glands of that group and also pass on to the next group. Hence, the lymphatic glands draining an area of cancer must receive careful consideration in treatment of that cancer.

The lymphatic vessels of the uterus fall naturally into two groups—those of the cervix and those of the corpus. Those of the cervix uteri join with those of the upper part of the vagina and empty into the sacral and hypogastric and superior iliac glands. The lymphatics from the corpus uteri join with those of the tube and ovary and empty into the lumbar glands. A few lymphatics from the uterine cornua pass along the round ligaments and empty into the inguinal glands.

Nerves

The nerves of the pelvic organs, like those of other internal organs, are derived from the autonomic nervous system. Fig. 68 shows the large autonomic trunk ganglia (vertebral ganglia) which lie along each side of the spine back of the abdominal viscera. Fig. 69 shows the complex reflex arc of the autonomic system (yellow and red) compared with the simple reflex arc of the spinal system (black).

The autonomic system is for the transmission of motor impulses of various kinds to the functioning structures, and it utilizes the sensory spinal nerves to

complete its reflex arc. For example, in the reflex arc shown in Fig. 69 the sensory impulse comes in over a spinal nerve (yellow), and passes to the autonomic nerve (red) at the synapsis in the cord. The outgoing motor impulse to the viscera passes along the autonomic nerve (red) in the posterior root and in the white ramus to the thoracic autonomic ganglion (vertebral ganglion) and on to the prevertebral ganglion, where there is synapsis with an autonomic nerve fiber going directly to the viscus. If the autonomic motor impulse is destined for the skin structures, it passes through a synapsis in the vertebral ganglion, then back through an autonomic fiber in the gray ramus

A.   B.
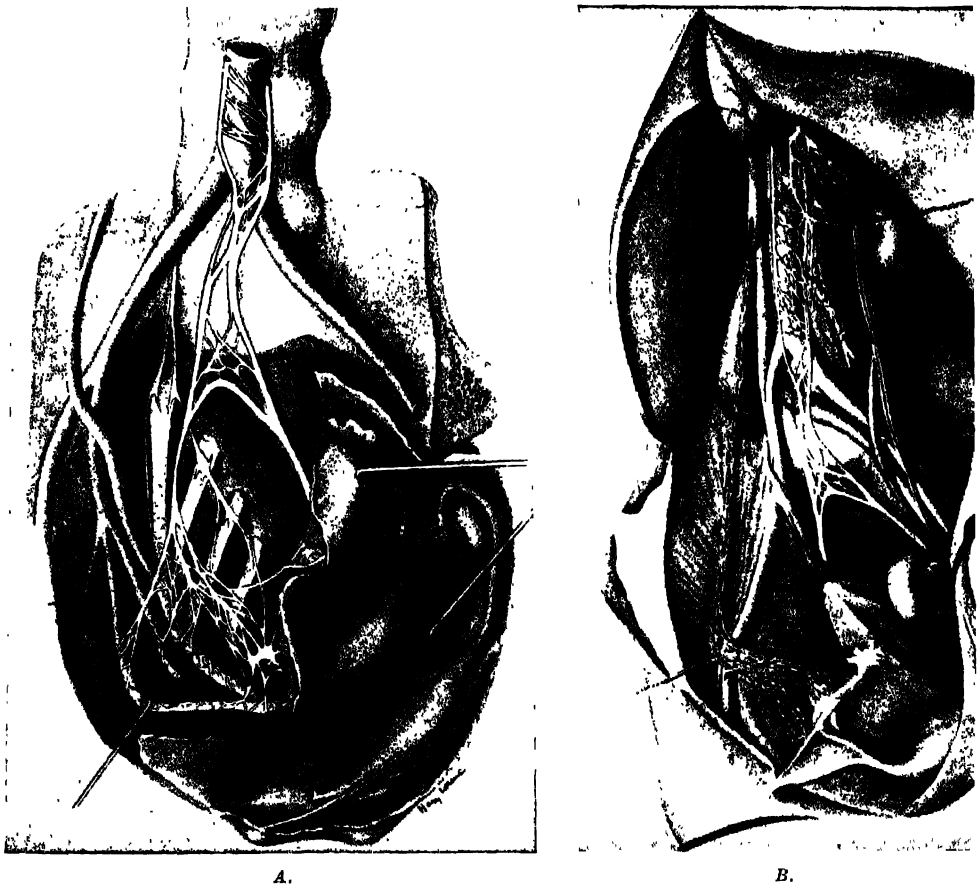
Fig. 71.—The nerve supply of the pelvic organs. A, Showing the superior hypogastric plexus and the right inferior hypogastric plexus. Showing also the extensions from the latter to the uterus and rectum. (Labate—Surg., Gynec. & Obst.)

B, Showing the right ovarian plexus of autonomic nerves, extending along the ovarian vessels and supplying the ovary and tube. (Labate—Surg., Gynec. & Obst.)

to the spinal bundle and on to its peripheral distribution. In the abdomen and thorax there are large collections of nerve fibers and within these are masses of synapsizing cells, each such mass of cells being called a ganglion, as in Fig. 69. Such a collection of nerve fibers and cells is also referred to as a plexus. The great collections in the abdominal cavity are indicated in Fig. 70, along with the fields they control.

——Sympathetic efferent fibers (Postganglionic)
--- Parasympathetic efferent f. (Preganglionic)
——Parasympathetic efferent f. (Postganglionic)
Afferent fibers which extend into the
sensory root of the spinal cord.

Cervical---
ganglion

Muscle

Arteriole

Muscle

Nerve fibers pass-
ing to various
elements of the
uterine wall
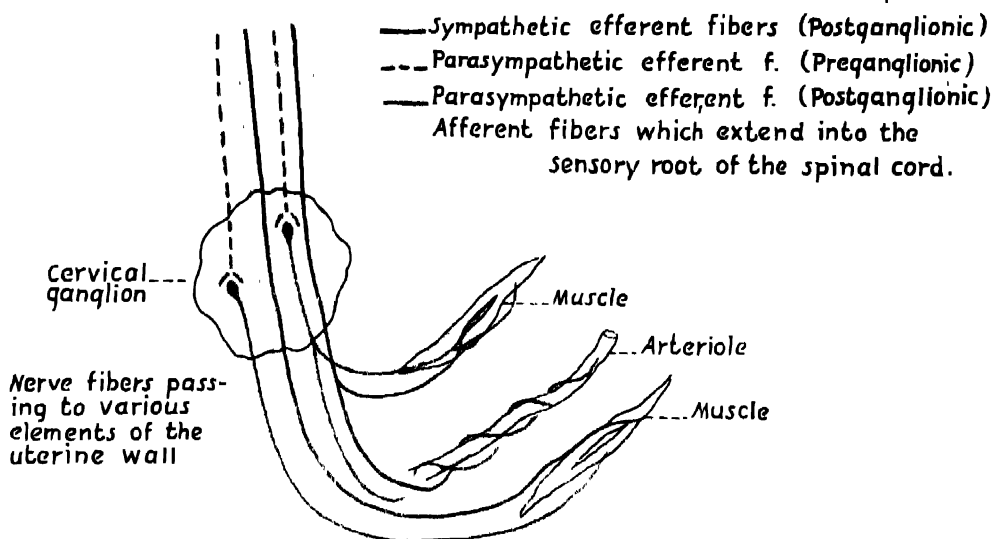
Fig. 72.—The nerve supply of the pelvic organs. Diagrammatic representation of the exten-
sions of the autonomic and spinal nerves into the functioning areas of the uterus.

SYMPATHETIC

PARASYMPATHETIC

1st neuron

1st neuron

Acetylcholin
produced here

2nd neuron

2nd neuron

Acetylcholin
produced here

Sympathin
produced
here

Cholin-esterase present
in tissues

Reacting cell

V I S C U S
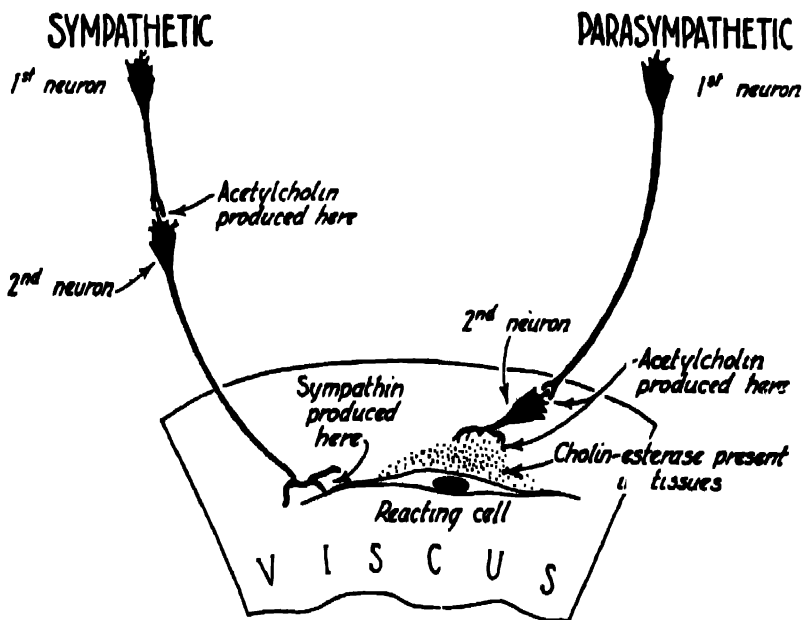
Fig. 73.—The nerve supply of the pelvic organs. The balance between sympathetic and para-
sympathetic nerves and esterase. (Myerson—*J. A. M. A.*)

The above detailed reflexes apply to the autonomic nerves issuing from the thoracic and lumbar segments of the cord. Those from other segments (sacral, cervical, mesencephalic) have a somewhat diffcrent reflex arc in that the motor impulse is carried by a continuous autonomic fiber from the cord to a local ganglion near the viscus, where there is a synapsis with the viscus fiber. In each type of reflex arc the autonomic fiber extending from the cord to the synapsis ganglion is called "preganglionic," and the fiber extending from the synapsis to the organ is called "postganglionic."

It is seen then that in the thoracic portion the synapsis between the preganglionic and the postganglionic fibers takes place in a main autonomic ganglion (vertebral or prevertebral) while in the cervico-sacral portions the synapsis takes place in a local ganglion near the organ innervated. The autonomic nervous system is thus divided into two parts, the thoracic portion being designated the "sympathetic" and the mesencephalic-cervical-sacral portion the "parasympathetic." In addition to the difference in location of the synapses, there is also a difference in function. In fact, the two parts of the system are largely antagonistic, such antagonism being necessary to adequate functioning of the organs. For example, in the pupil of the eye stimulation of the sympathetic fibers causes dilatation and stimulation of the parasympathetic fibers causes constriction.

This same contribution to complete functioning extends throughout the body wherever two active antagonistic actions are necessary. In some situations simple action (muscular contraction or cellular functioning) and relaxation will suffice, as in skin structures. Practically all internal organs, however, are supplied with both sympathetic and parasympathetic control, the fibers extending in various directions and to various distances to reach them. The distribution is shown diagrammatically in Fig. 70, the sympathetic nerves being indicated in red and the parasympathetic in blue. For each, the preganglionic fibers are indicated by broken line and the postganglionic fibers by solid line. The antagonistic actions of the two parts of the autonomic system are utilized in modern therapeutics, pharmacological experimentation having demonstrated that certain medicines stimulate the sympathetic nerves and others stimulate the parasympathetic.

The nerves of the uterus are derived from the superior hypogastric plexus, extensions from which form the inferior hypogastric plexus of each side, as shown in Fig. 71, A. These collections of nerve cells and fibers, like the great nerve masses higher in the abdomen, contain spinal nerves as well as autonomic nerves, for as previously explained the sensory portion of the autonomic reflex arc is supplied by the spinal nerves. Also, there is free communication between the various autonomic ganglia and between the autonomic and the cerebrospinal systems. From the inferior hypogastric plexus of each side nerves extend to the various pelvic viscera. The extensions to the uterus and rectum are shown in Fig. 71, A. Smaller ganglia are found near some of the viscera. A ganglion lying near the cervix on each side is known as the Frankenhäuser ganglion. In local anesthesia for vaginal hysterectomy the injection is made along the side of the cervix to anesthetize the area of the

cervical ganglion, for associated with the motor autonomic nerves are the sensory spinal nerves. The nerve supply to the ovary comes from higher, as shown in Fig. 71, *B*.

The minute extensions of the nerves into the functioning elements of the uterus are indicated diagrammatically in Fig. 72. The importance of these minute extensions into the area of cellular function, where nerve impulses meet endocrine and other factors which condition response, is indicated in Fig. 73.
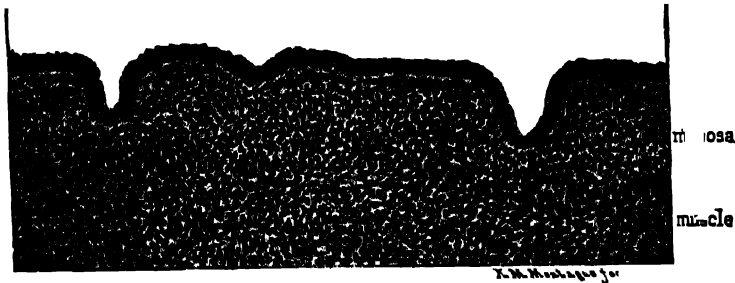
Fig. 74.—Endometrium of an infant, just born.   (Williams—*Obstetrics*, D. Appleton-Century Company.)
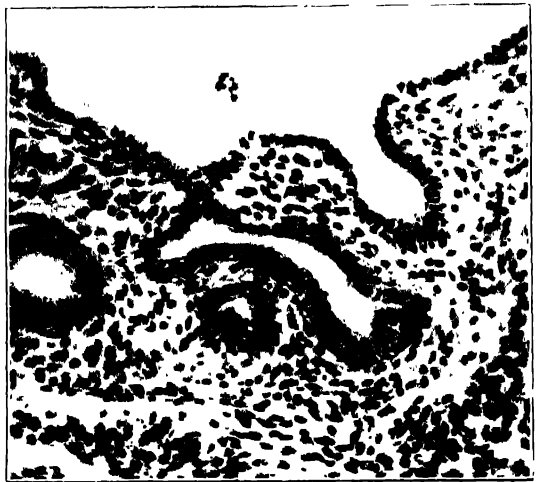
A.   B.

Fig. 75.—*A*, Microscopic section of uterine wall of child, aged eight years. Gyn. Lab.
B, Higher power of the upper central portion of *A*. Gyn. Lab.

PHYSIOLOGY

of the Uterus

The uterus has two functions: namely, menstruation and childbearing. The first is a preparation for the second. Menstruation with its various phases and associated endometrial changes will be considered here. Pregnancy and parturition belong to obstetrics.

In the years preceding puberty the endometrium develops slowly, the glands being formed by ingrowths from the surface epithelium, as shown in Figs. 74 and 75. As puberty is approached, more rapid development takes
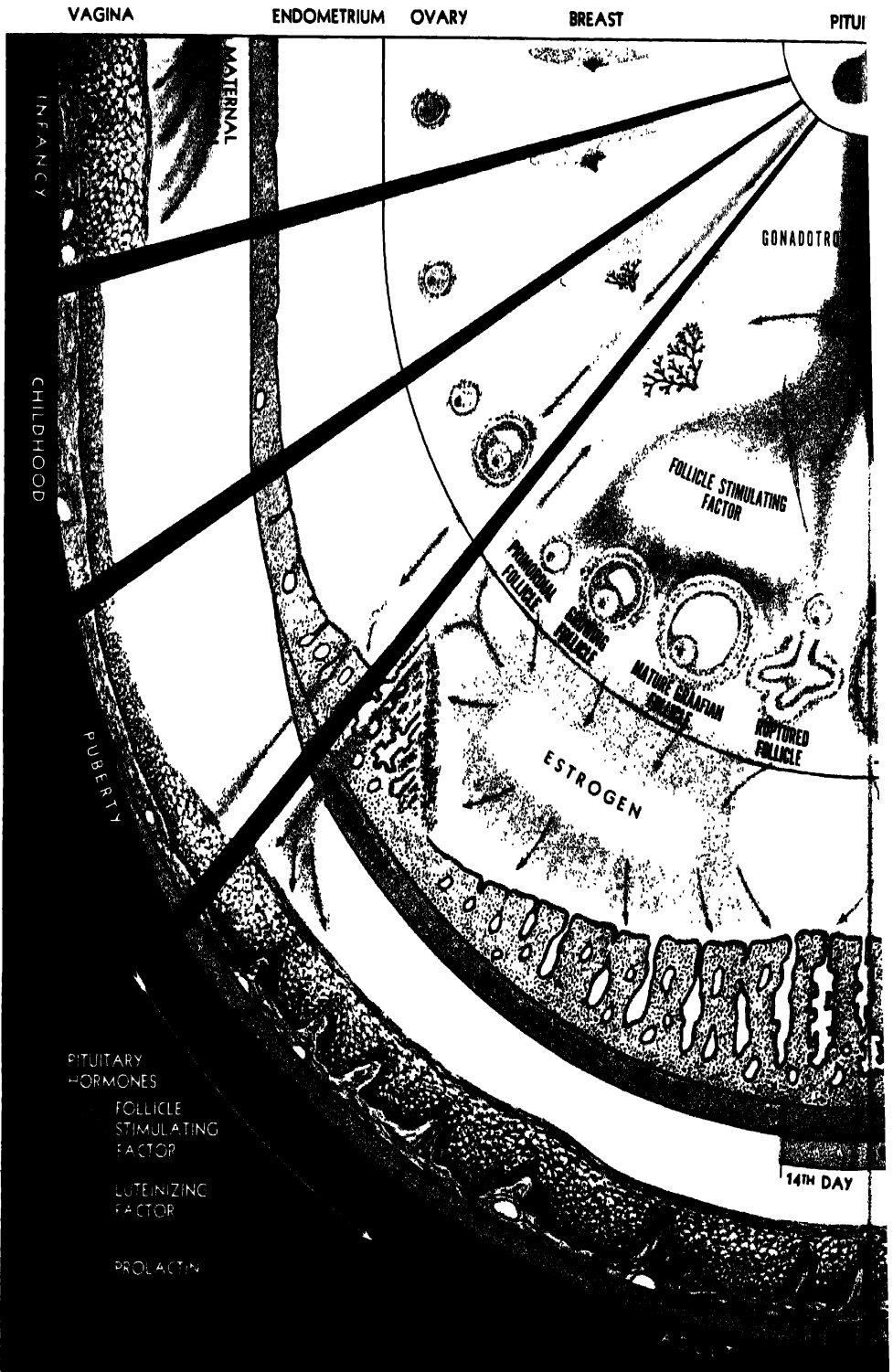
FIG. 76.—SCHEMATIC REPRESENTATION OF GENERALLY ACCEPTED HORMONAL PHY:

ITARY · BREAST · OVARY · ENDOMETRIUM · VAGINA

MONES

LUTEINIZING FACTOR

DEGENERATING CORPUS LUTEUM

CORPUS LUTEUM

PROGESTERONE

PLACENTA

28TH DAY

ESTROGEN

PROGESTERONE

SIOLOGY IN THE FEMALE. (Netter—Ciba Pharmaceutical Products, Inc.)
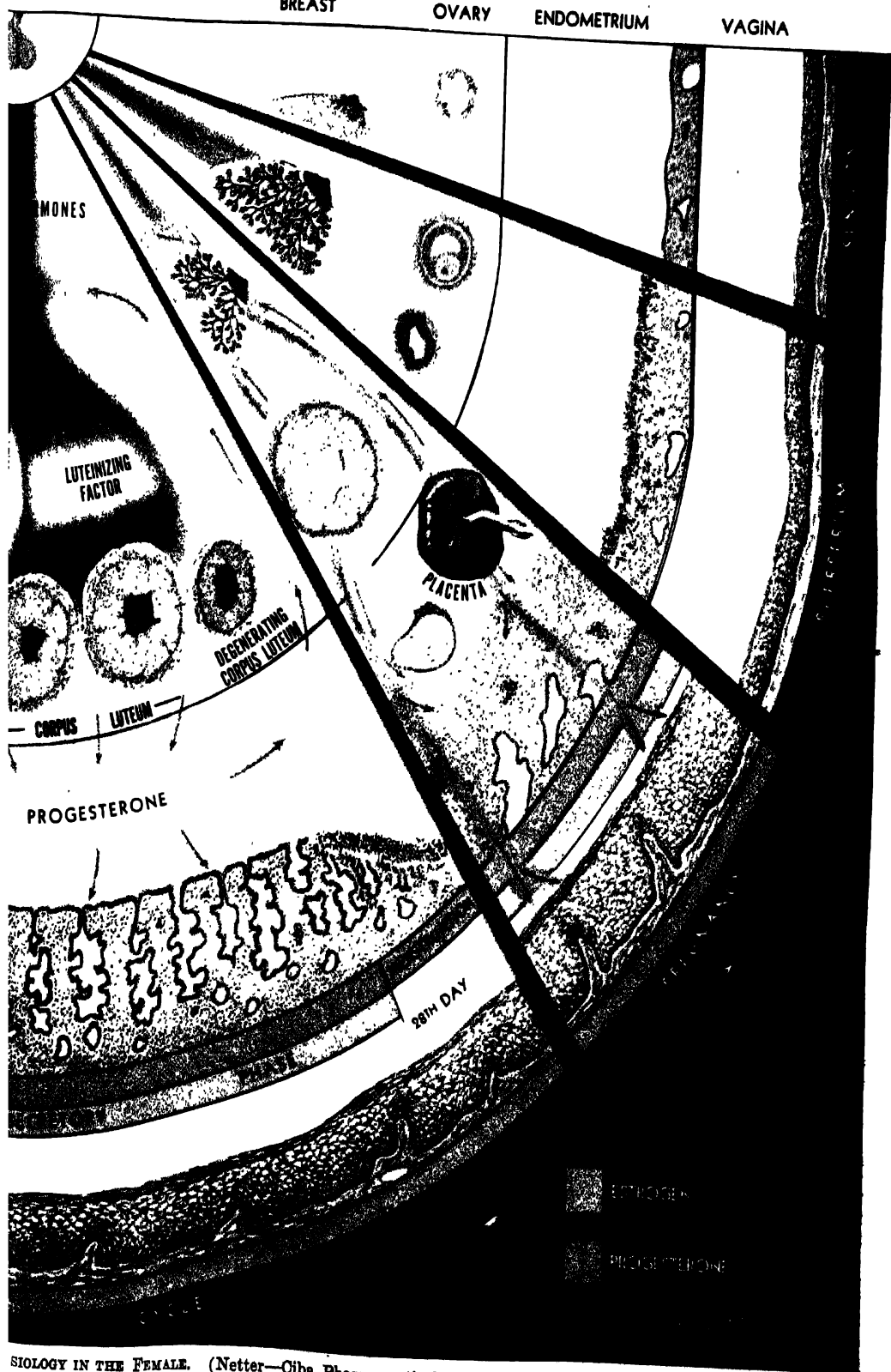
place in preparation for the change from a quiescent, fairly fixed structure to an actively functioning membrane, undergoing partial destruction and renewal every few weeks.

MENSTRUATION

Definition.—The term "menstruation" needs a clear and fixed definition. In the newer literature dealing with endocrine studies, it is used by different writers to express quite different concepts, with the resulting contradiction and confusion which always result from the use of ambiguous terms in the extended discussion on an intricate subject. In selecting a detailed definition, it seems advisable to start with a general one embodying the idea which has long received general recognition, namely, that menstruation is the bloody flow resulting from the breaking down of the endometrium normally prepared for pregnancy.

Now a definition defines a thing in a fixed way. If every person can change the definition of a term to suit his own particular view, it loses its usefulness as a means of conveying thought. The above time-honored definition seems a reasonable one and fully accords with modern physiologic and endocrinologic studies, and when the term is used it should mean exactly that—no more and no less.

Certain writers on endocrine topics use the term to express bloody flow without ovulation in that individual. In some of the conditions the bleeding is from a purely hyperplastic endometrium and in other cases from an endometrium sensitized to the secretory stage by progestin administration. In either case there has been no ovulation or corpus luteum formation in that individual, and hence no endometrium "normally prepared for pregnancy." Normal preparation for pregnancy presupposes ovulation and corpus luteum formation in that individual, and hence nothing which lacks these essential features should be designated as menstruation, if we wish to preserve clear-cut terms for accurate discussion.

We realize there may be some difficulty in selecting terms for these differing types of endometrial bleeding, but that is no excuse for killing the clear-cut significance of a well-established term, especially one of as much importance as menstruation. Such anomalous bloody discharge may be designated as nonovulation bleeding or anovulatory bleeding or hyperplasia bleeding or estrin bleeding or estrin-progestin bleeding. It might even be permissible to designate it as pseudomenstruation, though that tends to some confusion.

In dealing with the subject of menstruation there must be taken into consideration the following three phenomena:

Puberty and the beginning of menstruation (menarche).

Menstruation when fully established.

The menopause or cessation of menstruation.

1. **Puberty.**—Puberty is the period at which the girl matures and becomes capable of childbearing. This period is marked by a very rapid development of the sexual organs. The ovaries, uterus, vagina, and external genitals enlarge, hair appears in the pubic region and in the axillae, the breasts become more prominent, the pelvis enlarges, and the whole body becomes somewhat

larger and its outlines more rounded and graceful. These physical changes are accompanied by mental changes, which are indicated by modesty, sexual desire, and allied phenomena.

These changes take place usually between the eleventh and sixteenth years. When the proper development has been reached, the menstrual flow appears. This flow is the sign that development has taken place and that ovulation has begun. Ovulation, no doubt, occasionally occurs before the first menstruation appears, but, as the menstrual flow is the outward sign of the internal sexual preparation, the period of sexual activity is counted as beginning with the first menstrual flow. Likewise there may be a number of anovulatory cycles before the normal ovulatory mechanism is established.
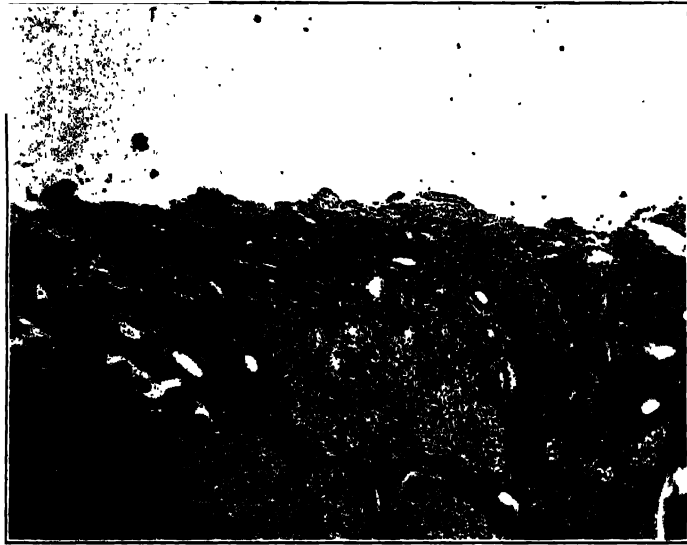
Fig. 77.—Endometrium at early growth stage. The breaking down of the endometrium is completed and the menstrual flow is well established. Probably the second or third day of menstruation. Gyn. Lab.

The age at which the first menstruation appears varies in different races and under different environments. Climate has long been thought to influence the beginning of menstruation—the colder the climate the later the first menstruation. This holds good as a general rule, the Laplander beginning to menstruate at about eighteen, while the inhabitant of hot climates at from nine to eleven. Engelmann has shown, however, that in some of the most northerly tribes menstruation appears as early as in the tropics. The mode of life has some influence, as has also the general health of the girl. Girls reared in the city begin to menstruate earlier, usually, than those reared in the country. In addition, there are the personal inherited tendencies, about which we know very little, but which exercise a marked influence on the phenomena of life.

Occasionally the beginning of menstruation is long delayed without any apparent cause. Hirst had a patient who menstruated for the first time at the

age of thirty-three, had four periods in the next two years, and then conceived two months later. He records also a reported case of a woman, married at thirty-four, who menstruated for the first time at the age of forty-five, and bore a child at forty-six.

In the United States a girl is expected to begin to menstruate when she is twelve or thirteen or fourteen. Not infrequently the menstrual flow begins at the age of ten or eleven, and hence when a girl reaches about the age of ten her mother should explain to her that a slight bloody flow may be expected and that it is nothing that need frighten or worry her, but is entirely natural.

2. **Menstruation.**—The menstrual discharge consists of blood mixed with secretion and epithelium from the uterus and with epithelium from the vagina. It is dark, and rather viscid or stringy from its admixture with cervical mucus. The menstrual discharge has also some odor, due to slight decomposition which takes place during its passage through the vagina. Menstrual blood taken directly from the interior of the uterus has no odor. If normal, the blood does not clot.

The amount of blood lost at each menstruation varies greatly in different individuals. Barer and Fowler found the blood loss in 100 women by extracting blood from pads and analizing iron content. They concluded that the average loss is 23 to 68 c.c., and the extremes 7 to 179 c.c. The rate of flow (i.e., whether or not the flow is too free) is estimated usually by the frequency with which the napkins have to be changed. The usual flow requires a change about three times daily during the height of the menstruation. If more frequent changing is necessary, the flow is too free.

There is considerable variation in the duration of the menstrual flow, the average being three to four days. Some perfectly healthy women, however, menstruate only one or two days and others six or seven days. The scanty menstruation or the profuse menstruation, as the case may be, seems to be normal for that particular individual. The duration of the flow in the same individual is about the same at the different periods.

Statistics on the periodicity have shown it to be irregular even in the same person. The average time is reckoned as about twenty-eight days. The cycle is counted as beginning with the first day of the flow. Arey made a study of 20,000 calendar records from 1,500 individuals of many races and varied ages. He found that an average woman must expect one-third of her menstrual cycles to depart more than two days from her mean cycle length. The mean cycle length, based on individual averages, was 33.6 days for girls and 29.5 for women. In no instance did perfect menstrual regularity appear over any significant period of time, though many women had previously believed themselves the acme of regularity.

Menstruation ceases during pregnancy and lactation. Exceptions to this rule are frequent. A few women menstruate for one or two periods after conception, and very often the menses return while a woman is still nursing her child.

The principal physiologic significance of menstruation is that it is a preparation of the uterus for the reception of a fertilized ovum.

Endometrial Changes

The relations of the cyclic endometrial changes to follicle-maturing and ovulation and corpus luteum formation are shown in Fig. 76 (folded color plate). The microscopic details characterizing the different stages of the menstrual cycle are shown by actual photomicrographs with explanatory drawings in Figs. 77 to 85.

In regard to designations for the stages of the cycle, understanding of the terms will be aided by keeping in mind that they refer primarily to changes in the endometrium. Ovarian changes and influences which accompany the endometrial "stages" are mentioned as "phases" in order to avoid the confusion which has resulted from the mixture and haphazard use of two sets of terms, one based on the endometrium and the other on the ovary. It must be kept in mind also that the time limits of the "phases" and "stages" are different, and hence that the imposing of one on the other is practicable in only a general way. For example, the luteal phase of ovarian influence on the endometrium is manifest in both the late growth stage and the premenstrual stage, but the endometrial picture in the latter is so different from the former that it constitutes a separate stage.

Another item is that the stages have only one point of coincidence with the menstrual flow, and that is that the beginning of the flow marks the breakdown which ends the premenstrual stage and inaugurates the next cycle of growth. Hence the "menstrual stage" has no relation to the length of flow but only to its beginning. The end of the flow determines no particular change in the endometrium; hence there is no occasion for the term "postmenstrual stage." The term "interval stage" also has been outgrown, for we know now that there is continuous growth from one breakdown to the next and consequently no resting or "interval" stage as formerly supposed.

The terms used in describing the stages of endometrial change are as follows: early growth stage (follicular phase), late growth stage (luteal phase), premenstrual stage, menstrual stage (breakdown). The breakdown is a piecemeal affair, still continuing in some parts of the endometrium while growth is advancing in other parts. However, as the classification is based on growth and as regeneration starts with the breakdown (first day of flow) the early growth is counted as beginning at that time, though some days are required for the development of typical features.

With the onset of menstruation there is tissue loss, with thinning of the thickened and softened endometrium. The extent of tissue loss probably varies with the individual and with the condition of the endometrium. According to Schröder, in most cases the endometrium is cast off down to the basal layer, leaving the lower end of the glands from which the new endometrium regenerates (Fig. 77).

Watson and McHenry, studying the tissue loss from the endometrium during menstruation, concluded that tissue loss during normal menstruation is limited to the epithelium of the glands which have been fully activated by progesterone and the stroma supporting that epithelium. The loss occurs only when the progesterone stimulus is withdrawn.
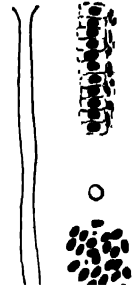
A.   B.

Fig. 78.—*A*, Early growth stage a little later than Fig. 77. Note the beginning regeneration of the surface epithelium at the right upper corner. Gyn. Lab.

B, Shows the general character of the glands, short, straight, narrow, with a round lumen. The lining cells are cuboidal with central nuclei. The stromal cells are closely packed, with very little cytoplasm. The detailed diagrammatic drawings in Fig. 78-*B* and also those in Figs. 79-*B*, 80-*B* and 85-*B* are modified from drawings by Novak (Am. J. Obst. & Gynec.) whose studies and writings have greatly assisted in the classification of these complicated endometrial changes.
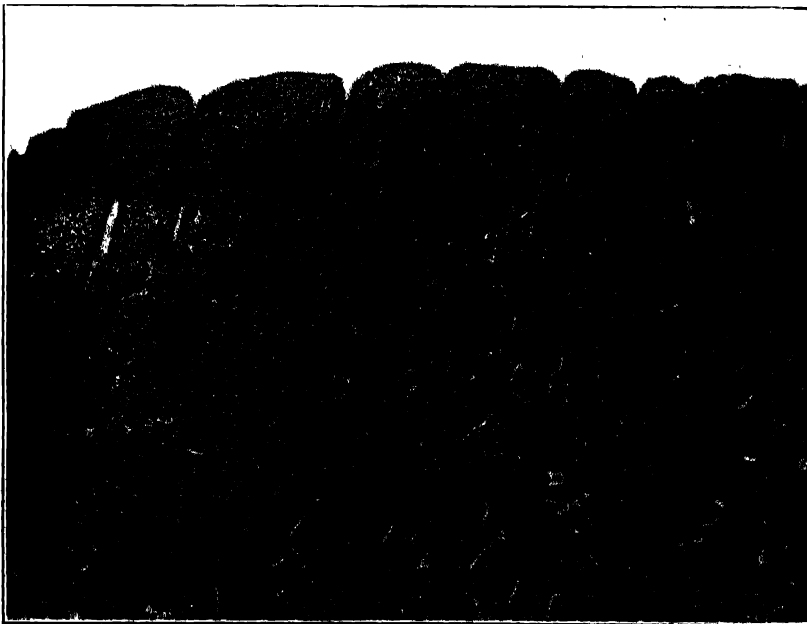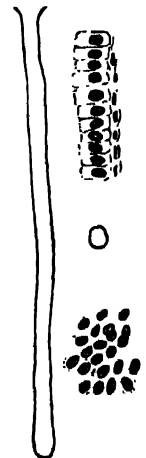
A.   *B*.

Fig. 79.—*A*, Endometrium in the early growth stage (eighth day of cycle). The endometrium is becoming rapidly rebuilt and already is almost back to its normal thickness. The glands are straight and collapsed. Gyn. Lab.

B, Diagrammatic sketch to show the character of the epithelial lining cells, the stromal cells, and the glands.

Early Growth Stage ("Follicular Phase").—The microscopic characteristics of this stage are shown in Figs. 78 to 79. Campbell, Lendrum and Sevringhaus, in describing the cycle, speak of a period of tissue loss (comprising the first day or two of bleeding), a period of re-epithelization (two days) and a pre-ovulatory "proliferative" period (ten to twelve days) in which the follicular hormone effect becomes fully developed.

In the early growth stage the growth is due chiefly to the action of estrone. By the end of the first week of this period there has been rapid growth of the endometrium, which becomes greatly thickened and somewhat edematous. There are numerous mitotic figures in the stroma and glandular epithelium. The glands become elongated but the lumen is still round and regular, as shown in Figs. 78 and 79. The epithelial cells lining the glands are inactive as far as secretion is concerned and the nuclei are still basal, and no glycogen or mucin

A.   B.
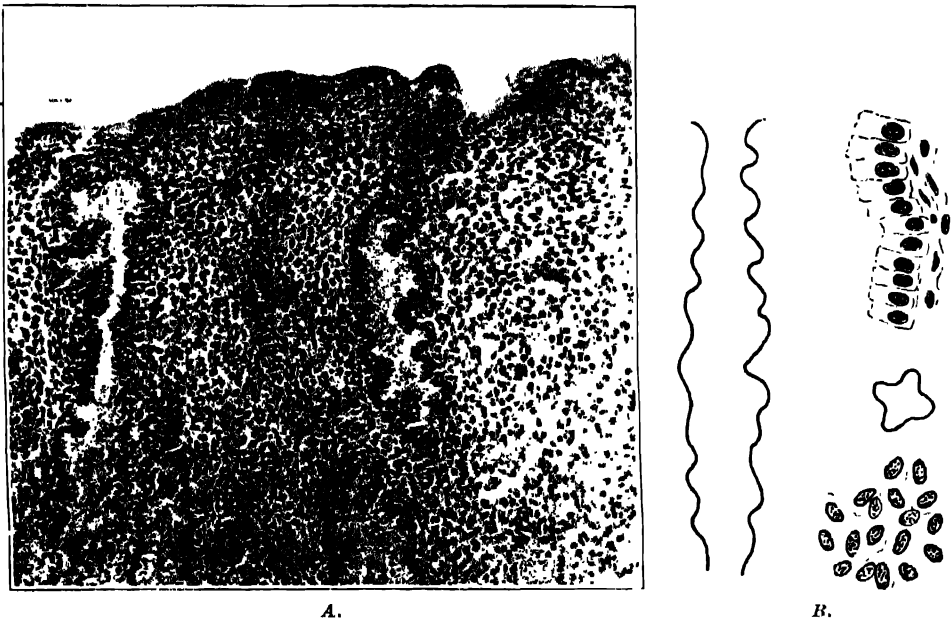
Fig. 80.—*A*, Endometrium in the late growth phase. (Twelve to twenty-five days after the first day.) The endometrium is back to its normal height. The glands are beginning to become tortuous and they are filling with secretion. The stromal cells, particularly those near the surface, are increased in size and varied in shape. These are due to the beginning action of progestin, secreted by the corpus luteum since the time of ovulation. Gyn. Lab.

B, Diagram showing the characteristics of the late growth stage. Irregular gland becoming dilated with secretion, epithelial cells lining the gland are enlarged and secreting, stroma cells enlarged.

is present. In the early part of this stage the interstitial tissue of the stroma is loose and fibrillar but later becomes progressively more dense.

Late Growth Stage ("Luteal Phase").—The typical features of this stage are shown in Figs. 80 to 83. In this latter part of the period of growth, after ovulation and corpus luteum formation, the influence of progesterone on the endometrium becomes manifest. Evidence of this progesterone effect is that the nuclei in the glandular epithelium are pushed from their basal position toward the center by masses of glycogen, leaving a clear area between the base of the cell and the nucleus. This change starts at the mouth of the gland and proceeds toward the deeper portion, but leaves the deep end unaffected.

The epithelial cells lining the glands become longer and longer and there is a decrease in the number of mitotic figures, and in two days the glycogen begins to migrate toward the lumen end of the cells. The position of these masses of glycogen can be clearly shown by special staining. Soon they appear as protrusions of the cells into the lumen of the glands, preparatory to the secretion of the glycogen into the lumen. This projection of glycogen from the cell ends gives a ragged frayed appearance, characteristic of this process and shown well in Fig. 83. Mucin appears in the lumen later than the glycogen, and it has never been found within the secreting cells. As the glands grow in this stage they become coiled and tortuous and irregular, as shown in the illustrations.

Fig. 81.—Premenstrual stage showing the upper layer of the endometrium. The saw-toothed edges of the glands are particularly noticeable in the section. The stroma is decidua-like. Gyn. Lab.

Premenstrual Stage.—In this stage there is a marked increase in the tortuosity of the glands and rapid growth of their epithelial lining. This rapid epithelial growth causes crowding, hence tufts of cells are pushed into the glandular lumen, giving the typical "saw-tooth" appearance, as shown in Figs. 84 and 85.

In the middle portion of the endometrium the growth and tortuosity of the glands are so marked that the stromal cells are forced toward the surface, forming there a compact layer. By this process the endometrium becomes divided into three zones: the superficial "zona compacta," where the stroma is fairly dense and the glands compressed and straight; the "zona spongiosa," composed of dilated coiled glands with very little between them, and the "zona basalis," containing the deep ends of the glands which are affected very little by the cyclic changes. These zones are well shown in the photomicrograph in Fig. 84. The stromal cells in the superficial compact zone become edematous and large and resemble decidual cells, but differ from them in that they contain no glycogen.
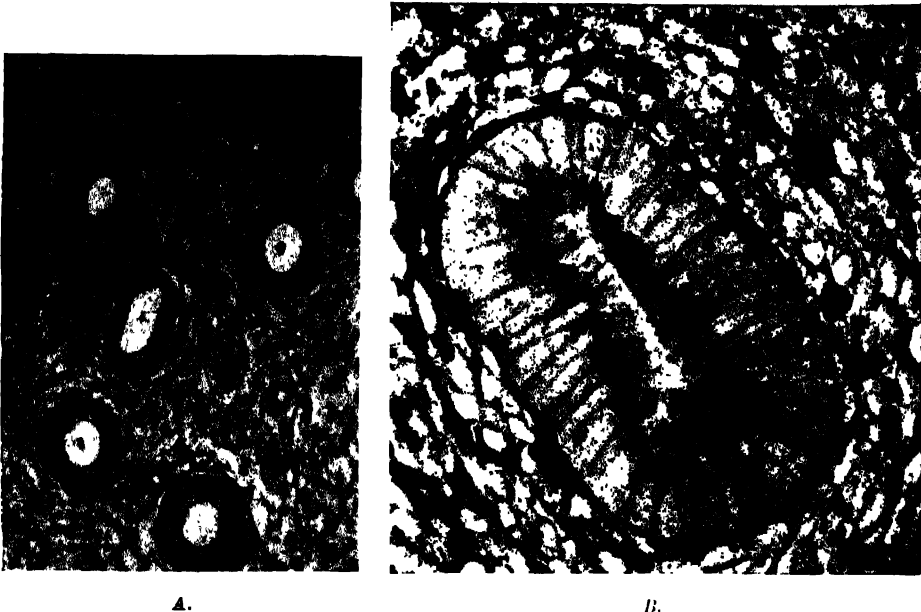
Fig. 82 *A* and *B*.—The follicular phase of the growth stage.

A, Specimen from a patient on the sixteenth day of the cycle. The follicular effect is fully developed. Ovulation probably occurred about this time. (×140.)

B, Special staining of gland, in follicular phase, to show Golgi apparatus. (×600.) (Campbell, Lendrum and Sevringhaus—Surg., Gynec. & Obst.)
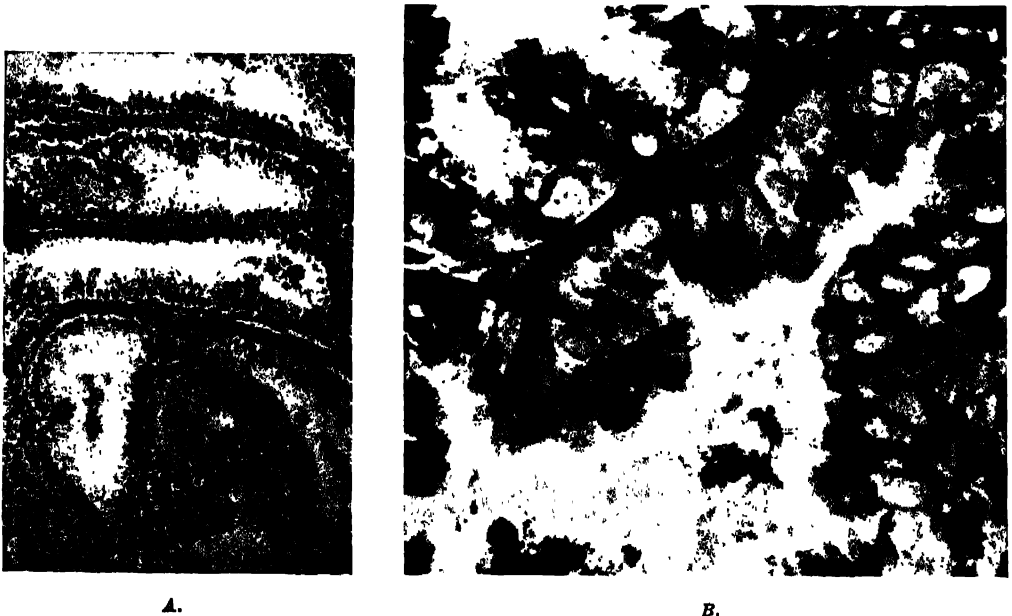
Fig. 83 *A* and *B*.—The luteal phase of the growth stage.

A, Specimen from same patient on the twenty-third day of the same cycle. The luteal effects are now well developed, but are still fairly early, as is evidenced by the presence in some places of a clear zone between the gland nuclei and the basement membrane. (×140.)

B, Special staining of gland, in luteal phase, to show Golgi apparatus. (×600.) (Campbell, Lendrum and Sevringhaus—Surg., Gynec. & Obst.)

Fig. 84.—Endometrium of premenstrual stage. (Twenty-five to twenty-seven days after the first day.) Marked tufting of the dilated glands which are also increased in number. Notice the superficial compact layer and the deeper spongy layer similar to a decidua. This is due to the large amount of progestin from the mature corpus luteum present in the ovary at this time. Gyn. Lab.
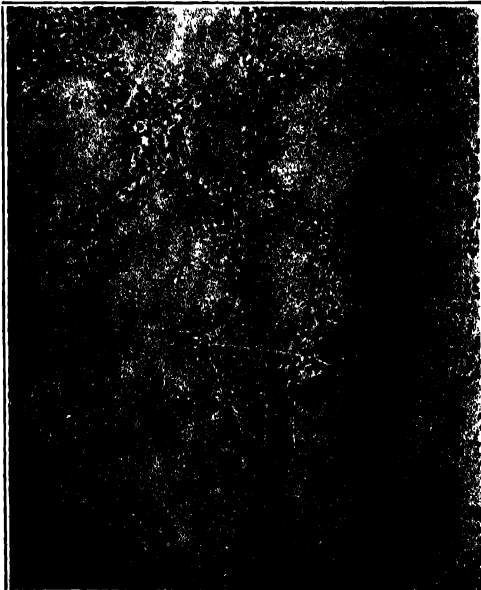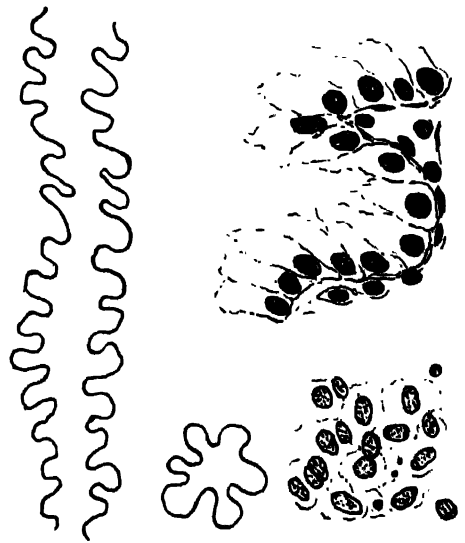
A.   B.

Fig. 85.—A, Premenstrual endometrium. High power of Fig. 81, showing the markedly distended tortuous glands and the large stromal cells. A capillary distended with blood elements just below the center of the section. "Tufting" effect well shown. Gyn. Lab.

B, Diagram showing the characteristics of the premenstrual stage mentioned in A. Longitudinal section showing the saw-toothed edges of the gland, shown also in cross-section. The large epithelial cells covering the tufts are illustrated as are also the large clear stroma cells.

The great thickening attained by the endometrium in the premenstrual stage is shown in Fig. 86, which is a uterus removed just before the menstrual breakdown. Notice the distinct rolled margin at the lower portion of the full-functioning endometrium where it joins the mucosa of the "isthmus," which is the transitional area of the uterus where the corpus shades into the cervix.

This stage is followed by the endometrial breakdown, and this inaugurates the next cycle.

Menstrual Stage (Breakdown).—This is the stage in which the built-up endometrium crumbles and is cast off, usually to the basal layer. The remaining portions of the glands are generally collapsed and the stroma is filled with dilated capillaries, and there are red cells in the tissue spaces. The process by which the blood gets into the spaces is not proved, but most authorities feel that diapedesis is more common than rhexis. Figs. 87 and 88 show the endometrium of this stage.

Cyclic Arteriole Changes of Menstruation

Though these changes occur simultaneously with the above-described cyclic epithelial and glandular changes and are an integral part of the mechanism of menstruation they are discussed separately to avoid confusing the two phenomena. The observations of Markee on endometrial tissue transplanted into the eye of rabbits and monkeys and the work of Daron on the anatomy and histophysiology of the endometrial vascular components in the monkey advanced greatly our understanding of the mechanism of endometrial bleeding and disintegration. Some of the observations made by them in animals have been made also in human beings by means of hysteroscopic studies. Mikulicz-Radecki described transient blanching of the endometrium just before the onset of bleeding. Schröder confirmed this and described a pale, swollen, glassy mucosa on the twenty-sixth day of the cycle. It is now known that the recurring vascular cycles of the spiral arterioles are the same in cyclic uterine bleeding whether the endometrium is proliferative or secretory or hyperplastic, hence menstruation is fundamentally a vascular phenomenon.

The **spiral arterioles** arise from the arcuate branches of the uterine artery in the middle third of the myometrium and extend inward. In the inner fourth of the myometrium they are perpendicular to the uterine cavity, and after penetrating the endometrium they extend to the surface without giving off any branches. The spiral arterioles as they pass through the inner fourth of the myometrium are surrounded by specialized muscle tissue made up of fibers from the surrounding myometrium. These periarteriole collections of special muscle fibers were called *contraction cones* by Markee, who described them in the monkey. In human beings, groups of longitudinal muscle fibers immediately beneath the tunica intima of the arterioles in the female genital tract were described by Bucura. These fiber groups, named "polsters" by Bucura, are especially abundant around the arterioles of the inner fourth of the myometrium, and Keiffer has shown that the fibers of the tunica are continuous with the intrinsic muscle fibers of the myometrium.

The muscle cones surrounding these spiral arterioles are under hormonal control, and the terminal portions of the arterioles in the endometrium atrophy when there is constriction by prolonged contraction of the muscle cones. This interference with the blood supply to the endometrium in the area of the terminal arterioles affected causes disintegration of the endometrium in those areas. The basal layer of the endometrium is supplied by another group of arteries, which are not under hormonal control and hence do not undergo cyclic changes. Thus the fundal portions of the glands, which lie in the basal layer, are preserved for regeneration of the endometrium.
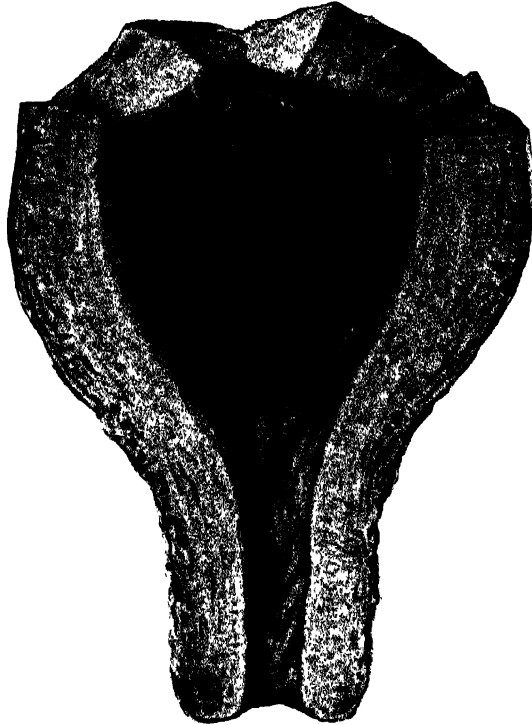
Fig. 86.—A uterus removed in the premenstrual stage, showing the marked thickening of the endometrium. In this specimen the "isthmus" of the uterus stands out clearly. The "isthmus" is the intermediate zone lying between the fully-functioning endometrium and the cervix, and represents a transition from endometrial to the cervical type of mucosa. Notice the thick roll at the lower border of the functioning endometrium. Gyn. Lab.

During the first three weeks of the cycle the spiral arterioles alternately contract and dilate causing periods of blanching and of blushing of the endometrial surface lasting from thirty to ninety seconds. During the premenstrual stage the endometrium becomes paler, and the blood flow through the superficial arterioles is markedly slowed. With the death of the corpus luteum and the consequent withdrawal of estrone and progesterone, the nourishment to the endometrium is withdrawn and there is a marked shrinkage due to water loss. With the endometrial involution, the arterioles become tortuous and coiled, the blood flow is definitely impeded, and leucocytes invade the stroma.

These events immediately precede menstruation, and in the course of the next twenty-four to thirty-six hours one after another of the coiled arterioles

clamp down so that there is no movement of blood cells in the superficial zone, though the circulation is normal in the basal zone. The cause of this sudden clamping down of the arterioles is thought by Markee to be due to injured-tissue products which act as vasoconstrictors for the special muscle cones about the spiral arterioles, the tissue-injury being due to the previous slowing of the circulation.

Several hours after the arterioles have clamped down, some of the arterioles open and allow blood to pour into the surrounding tissue. In the course of a few minutes a subepithelial hematoma develops. It soon ruptures and dark blood streams out on the surface of the endometrium. Necrosis sets in at the surface and the ends of the spiral arterioles are sealed by dead cells. An arteriole that has bled usually does not bleed again during this flow, though the blood does not clot. Small fissures appear at the edge of the blood-soaked area, and as they extend deeper into the tissue small areas of endometrium are loosened and cast off.

Fig. 87.   Fig. 88.

Fig. 87.—Endometrium menstrual stage. Shows beginning crumbling and hemorrhage in the superficial layer. Gyn. Lab.
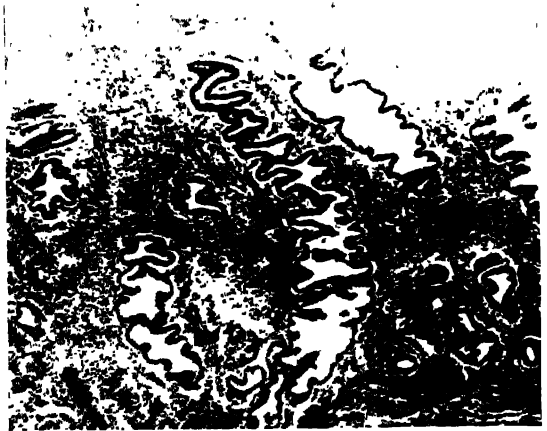
Fig. 88.—Endometrium menstrual stage somewhat later than that shown in Fig. 87. There is a loss of the superficial tissue, but the glands are not yet completely collapsed. Gyn. Lab.

This process is repeated in other areas during the next two or three days so that by the third or fourth day of the flow the endometrium is irregularly denuded. Regurgitated blood slowly oozes from the open veins and the surface becomes clean. This is soon followed by a migration of cells from the torn glands, and the surface epithelium is completely restored in the course of a few hours.

During the entire menstruation the basal circulation has continued, and it is now accelerated. From the stumps of the coiled arterioles capillary sprouts develop and the superficial capillary bed is rapidly re-formed. The new arterioles grow with the endometrium, and as their growth is more rapid than that of the stroma they become spiral.
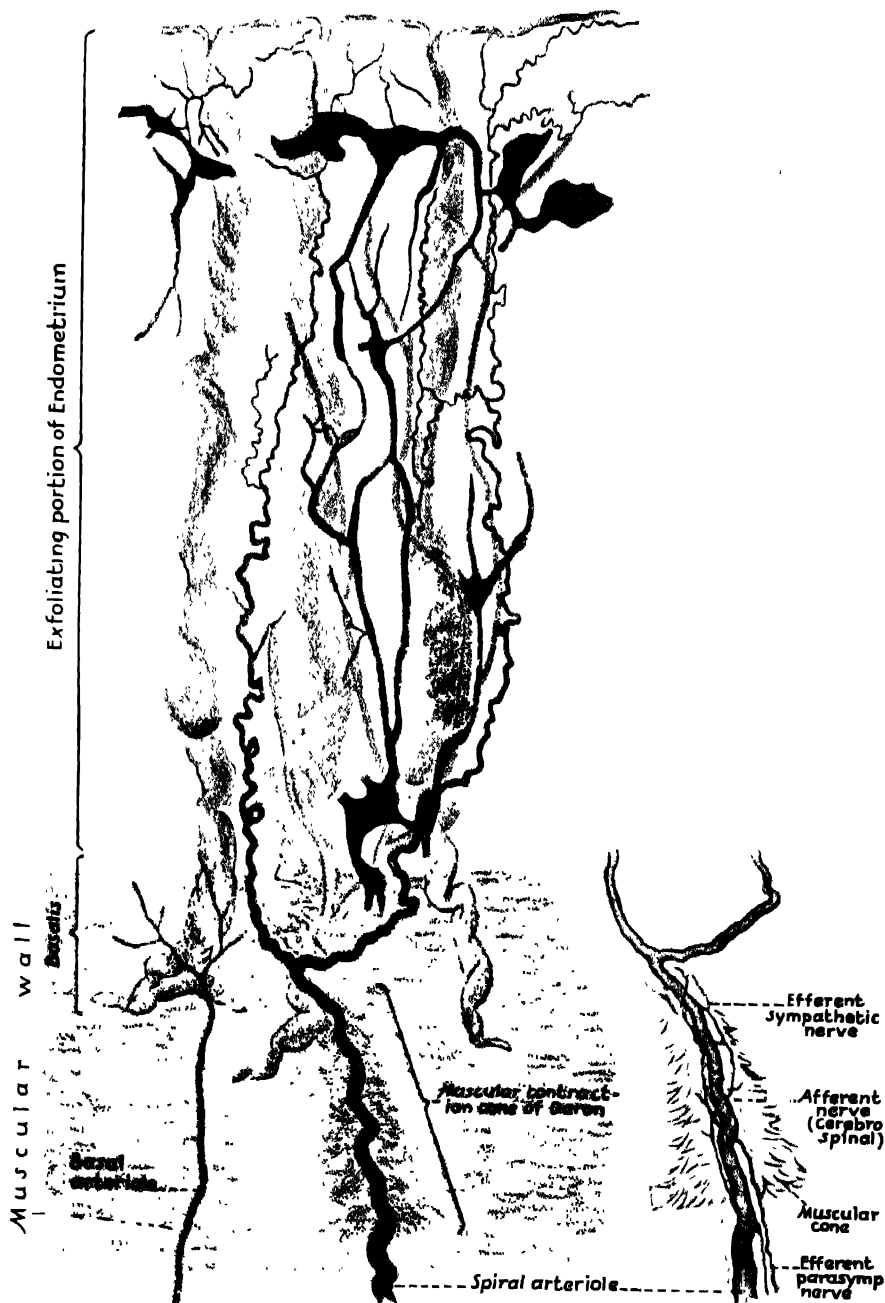
Fig. 89.—This colored diagrammatic illustration follows closely the original reconstruction of the elements by Bartelmez from serial microscopic sections of specially prepared and stained endometrial tissues.

The spiral arterioles of the endometrium are largely terminal and the blood supply through each is under the control of the muscle cone of Daron, shown in the illustration. Hence the nutritional integrity of the terminal area can be lowered by contraction of the arterial muscle cone, so that the area ceases to thicken by growth and later shrinks and disintegrates. The bleeding which follows is blood released by the cellular disintegration, apparently largely from the venous sinuses of the area.

The basalis zone of the endometrium is supplied by other arteries, not under hormonal control and not subject to the cyclic changes and exfoliation. Thus the deep ends of the glands are preserved for regeneration of the endometrium. (After Bartelmez—*Am. J. Obst. & Gynec.*)

Daron made reconstructions of the spiral arterioles from serial sections of the menstruating endometrium in the monkey. Bartelmez made reconstruction of the elements of the endometrium in the human, showing spiral arterioles with their muscular contraction cones, and also the glands and venous sinuses and lymphatics, and it was from this reconstruction that the colored illustration, Fig. 89, was made.

The demonstration of this terminal arteriole control of endometrial nutrition and disintegration has been carried a step further by Jones and Brewer, who used uteri removed in tubal pregnancy cases for their studies. Such uteri are specially suitable for this purpose in that they are removed for a lesion outside the uterus and the conditions inside the uterus closely simulate menstrual disintegration and bleeding. They demonstrated by photomicrographs the terminal arteriole and the endometrial disintegration in the area it supplied.

Fig. 90.   Fig. 91.

Fig. 90.—Endometrium in a case of hyperplasia showing ciliated cells lining an endometrial gland. Cilia are rare in normal endometrium, but in hyperplasia one often finds scattered endometrial areas exactly resembling tubal epithelium, with all three of the characteristic tubal cell types. (Novak—Am. J. Obst. & Gynec.)

Fig. 91.—Another example of tubelike epithelium in the endometrium of a case of hyperplasia. Ciliated cells (C), and secretory cells (S). (Novak—Am. J. Obst. & Gynec.)

What controls the muscle cone governing the blood supply through the arteriole? Is it controlled by nerve impulses or by endocrine influence? Tracing the uterine nerves to their minute terminations, it is found that sympathetic and parasympathetic fibers pass to the functioning elements of the uterine wall, as shown diagrammatically in Fig. 89. Hence the arterial muscle cone is under control of the sympathetic and parasympathetic nerves. These nerves are influenced by various pharmacological substances, and by endocrines. It is well known that the cyclic changes in the endometrium are under endocrine control, and it is reasonable to suppose that this endocrine control is exercised through the neuro-muscular apparatus just mentioned, for it is there ready and is well suited to the purpose.

The endocrine influence may be exercised by remote effect, through the nerves, or by direct local effect on the nerve-endings and muscle fibers. Possibly both pathways are used, but the local influence is evidently large, for menstrual disintegration and exfoliation of the endometrium takes place a little at a time in a spotty way. Also, it takes place when remote influence has been eliminated by division of the nerves, as in Markee's transplantations of endometrial tissue into the eye.

The marked menstrual changes in the endometrium are not manifested equally in all parts of the membrane. Novak calls attention to this in the article previously referred to, emphasizing the strikingly different characteristics which the original coelomic epithelium develops in the different segments
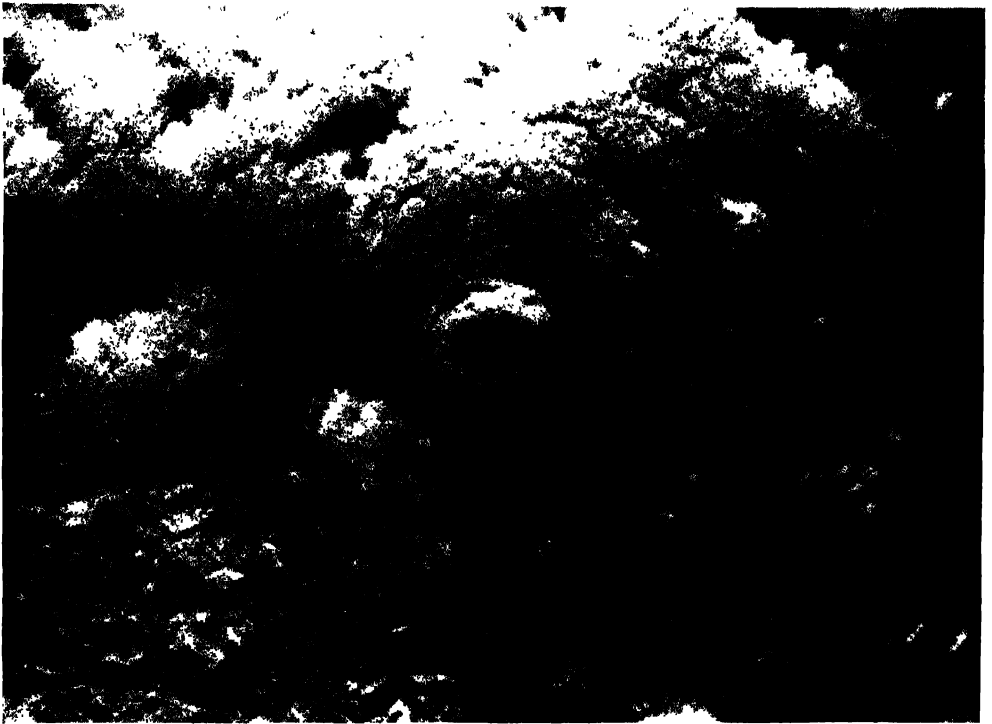
Fig. 92.—Magnified surface view of the endometrium. Notice the gland openings and the irregularity of the surface. The rounded mass in the center is a fertilized ovum, just sinking into the endometrium. (Carnegie Institution—*Scientific Monthly.*)

of the genital canal. Even in this single segment (endometrium), a stimulation brings different functional response in different parts, as manifested in the so-called "stratum reaction."

Another indication of the variability of cellular response to stimulation is seen in the development of tubal types of epithelium in the endometrium. This is rare in the normal endometrium, but with a slight shift in endocrine balance, as in hyperplasia, there may be reversion to the tubal type in spots. Fig. 90 shows in the endometrium the ciliated type of tubal epithelium and Fig. 91 shows the secretory type. This reversion to the tubal type of epithelium is seen even in the cervix occasionally.

The ovarian-pituitary (endocrine) factors causing menstruation have been discussed, but there may be also a local factor increasing the permeability of the vessel walls to the blood cells. The origin and nature of this factor have not yet been determined. Probably it is also concerned in preventing coagulation of menstrual blood. Frankl thinks that a tryptic enzyme secreted by the endometrial glands is responsible.

A magnified photographic view of the surface of the endometrium is given in Fig. 92. Notice the irregularity of the surface and the openings of the uterine glands. Incidentally, an ovum is just becoming implanted in the thickened endometrium.

In regard to cyclic changes in the cervix, Wollner feels that the epithelium lining the cervix goes through cyclic changes which are influenced by the hormones. The two most evident stages are shown in Figs. 93 and 94, the legends of which explain the characteristics.

Cyclic Motility of the Uterus

Cyclic motility of the uterus is well defined in experimental animals, but in the human there is still considerable uncertainty, in spite of the several methods of investigation. Though the local irritation of the intrauterine balloon method renders its records open to doubt as a typical physiological response, it seems to have established that the amplitude of the uterine contractions was increased by estrone and diminished by progesterone.

Dickinson developed a method of rectal palpation in the human, similar to that used by Hartmann in the monkey, by which he determined the contractility of the uterus. He found that at the time of the menses there are moderate contractions of the uterus. From the fifth day to the ninth of the cycle the uterus is quiescent but firm. Starting with the ninth day, the musculature becomes increasingly active, with a period of maximum contractions at about the fourteenth to the sixteenth day. The uterus contracts and relaxes, and the wave of contraction seems to travel from the tubal ends toward the cervix. As the cycle proceeds to the post-ovulatory stage the uterus again becomes quiescent until two days before the next menstruation. With menstruation there are contractions but these are never of the intensity of those coming at ovulation. His findings are illustrated in his article.

3. **Menopause.**—In a healthy woman menstruation ceases at the age of forty-four to forty-seven. There is considerable variation in this respect, the menses sometimes ceasing three or four years before that age or continuing some time afterward. This period of cessation of menstruation, known popularly as "change of life," is designated technically the "menopause." The two terms "menopause" and "climacteric" were formerly used interchangeably as though synonymous, but they really refer to two distinct though related phenomena. As our fund of knowledge increases and lines of investigation and discussion multiply, there is increasing necessity for exactness in the terms employed in medical study and exposition.

The changes that take place in the uterus during and after the menopause are similar to those occurring in all the genital structures, namely, a gradual atrophy of the functioning parts (endometrium and muscular tissue) and a general fibrous change (Figs. 95 and 96), and a slow diminution in size.

Fig. 93.

Fig. 94.

· Fig. 93.—High power photomicrograph of a specimen obtained seven days after the onset of menstruation. The surface epithelium forms a regular line of moderately high columnar cells with oval-shaped nuclei near the basal membrane. The cells have a sharp outline. The stroma is dense, the cells are widely scattered, and reveal little cytoplasm. (Wollner—Surg., Gynec. & Obst.)

Fig. 94.—High power photomicrograph of a specimen taken from the same patient twenty-three days after the beginning of her last menstruation. The regularity of the arrangement, size, and shape of the epithelial cells is lost. The cells are higher and broader than in the previous specimen and they have now an irregular outline. Some of them reveal the discharge of their secretion. The nuclei are larger, spindle shaped and situated near the center of the cell The stroma is markedly cellular and the cells have more cytoplasm. (Wollner—Surg., Gynec. & Obst.)
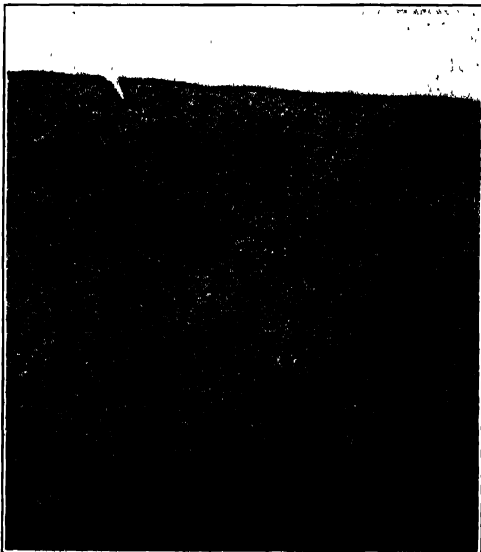
Fig. 95.
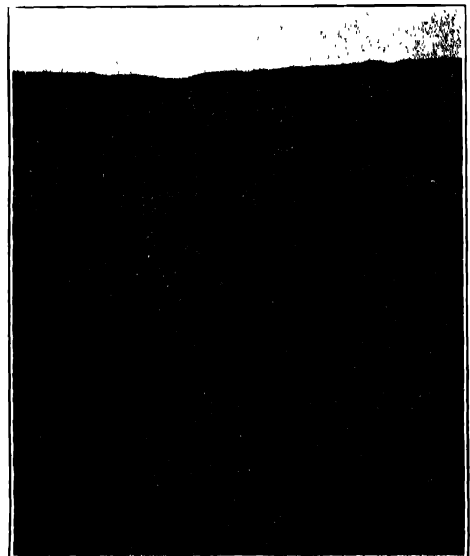
Fig. 96.

Fig. 95.—Senile endometrium, from patient aged sixty-two years, showing marked thinning of endometrium, stroma scant, and glands few. Entire thickness of endometrium only ½ mm.

Fig. 96.—High power of same specimen, showing the atrophic changes in the stroma and glands. Gyn. Lab.

The menses usually cease gradually—that is, the flow may be less free or may continue a shorter time than usual, or the flow may be missed entirely for one or two periods. This partial and irregular absence of the menstrual flow may continue for one or two or three years before it ceases entirely. This gradual diminution of the menstrual flow is natural and there are frequently slight nervous disturbances ("hot flashes," etc.) that can hardly be classed as pathologic. But many of the symptoms that are ordinarily considered as part of the "change of life" are really not so; for example, increased menstrual flow, bloody discharge between the menstrual periods, leucorrhea, pelvic pain. These are due to pathologic conditions. They mean that something is wrong, and they require investigation, that the trouble may be remedied.

This is important especially in the case of vaginal discharge, whether bloody or leucorrheal. It seems to be the general impression among women that irregular bloody discharges are natural during the "change of life." But such discharges are not natural—they usually mean either inflammation or cancer. One of the saddest things in gynecologic work is that a large proportion of the cases of cancer of the uterus are beyond the possibility of a cure when first examined. In such a case it is supposed by the patient and her friends that the slight bloody discharge which at first appears is "natural to the change of life," and so no attention is paid to it. Later, too late, they find that it is due to serious disease, which, because of neglect, has progressed to such an extent that it is beyond cure.

FALLOPIAN TUBES

The fallopian tubes, or oviducts, are two small muscular tubes, one on each side, which extend from the fundus uteri outward in the upper part of the broad ligament toward the pelvic wall (Figs. 51, 66). Each tube has a small central cavity extending its whole length. The inner end of this cavity communicates with the uterine cavity and the outer end opens into the peritoneal cavity. Thus there is a direct opening from the outside of the body into the great peritoneal sac, through the vagina, uterus, and fallopian tubes. This is why infection of the genital tract in a woman leads to peritonitis so much more frequently than infection of the genital tract in a man—the infection in the vagina simply extending along this mucous tract directly into the peritoneal cavity.

The tubes vary considerably in size and somewhat in shape in different individuals. The length of each tube is from three to five inches and the direction is outward, backward, downward, and inward—somewhat resembling a shepherd's crook—and partly surrounding the ovary.

That portion of the tube lying in the uterine wall is known as the **interstitial portion** or uterine portion. It has a very narrow lumen (Fig. 97). That portion of the tube extending from the margin of the uterus to the beginning of the curve is called the **isthmus**. It is about an eighth of an inch in diameter and is firm. The lumen is small, but becomes gradually larger toward the outer end (Fig. 98). The outer, curved, dilated portion of the tube is known as the **ampulla.** It is about the size of a lead pencil and the lumen also is much larger than that of the isthmus (Fig. 99). The outer end of the tube is known as the

fimbriated extremity or the infundibulum. This consists of a funnel-shaped expansion surrounded by a fringe of slender, fingerlike processes called ''fimbriae.'' One of these, which extends to the ovary and is attached there, is called the ''ovarian fimbria.''

In structure the wall of the tube is largely muscular, resembling the uterus. In fact, it is derived from the same fetal organ as the uterus. The tube lies beneath the peritoneum of the upper margin of the broad ligament, and its wall presents three layers: peritoneal, muscular, and mucous.

The **peritoneal layer** does not differ materially from peritoneum elsewhere. It is composed of flat endothelial cells lying on a basis of firm connective tissue. Immediately beneath the peritoneum is a layer of connective tissue sometimes called the subperitoneal layer. In this run blood vessels and lymphatics. The interstitial portion of the tube has, of course, no peritoneal layer, as the muscular tissue of the tube is in immediate contact with the muscular tissue of the wall of the uterus.
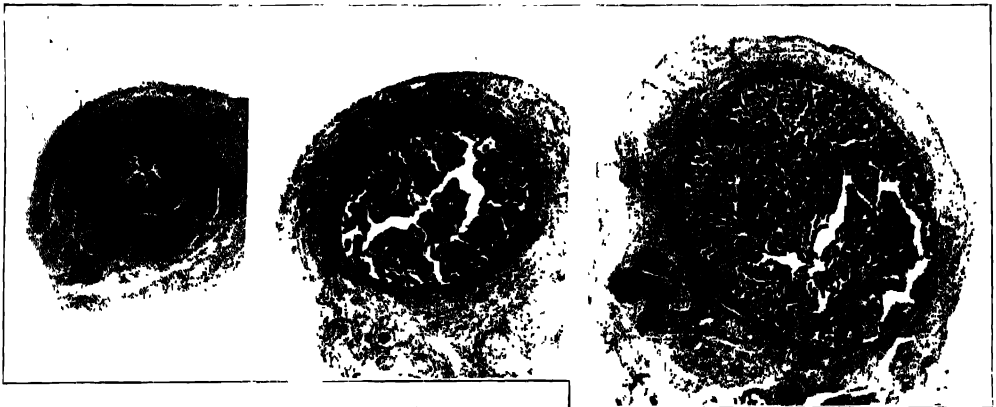
Fig. 97.   Fig. 98.   Fig. 99.

Figs. 97 to 99.—The lumen of the tube at different portions. Notice the progressive increase in size of the lumen from the uterine end outward. Fig. 97, the uterine end; Fig. 98, the middle; Fig. 99, near the outer end. Gyn. Lab.

The **muscular layer** of the tube is composed of involuntary muscular tissue, disposed in two strata, an outer longitudinal and an inner circular. Both of these strata are continuous, with similar muscular strata in the uterus. The internal stratum sends prolongations of muscular tissue into the four principal folds of the mucosa. The muscular layer is thinner at the abdominal end than at the uterine portion of the tube. The increased thickness of the wall at the abdominal end of the tube is due to the many folds of mucosa.

The **mucous layer** of the tube, like the uterine mucosa, is placed directly upon the muscular layer—there is no intervening submucosa. The tubal epithelium consists of two types of cells: the ciliated or nonsecretory and the nonciliated or secretory. Beneath the epithelial layer the mucosa is composed of ''stroma cells,'' very much like those found in the uterus, except slightly smaller. Between the stroma cells is a delicate connective tissue framework. There are found also capillary blood vessels and small lymph channels.

There are no glands in the tubal mucous membrane. The depressions which look like glands are due simply to the folds of the mucous membrane. As there

are no glands in the tube, there can be no mucous secretion, such as takes place in the uterus. The fluid by which the tube is distended in certain pathologic conditions is inflammatory exudate and not glandular secretion.

The mucous membrane is much folded longitudinally. There are four principal folds into which prolongations of the muscular tissue take place. There is no muscular tissue in the many smaller folds. In the interstitial portion and in the isthmus the folds are few and simply longitudinal, but in the
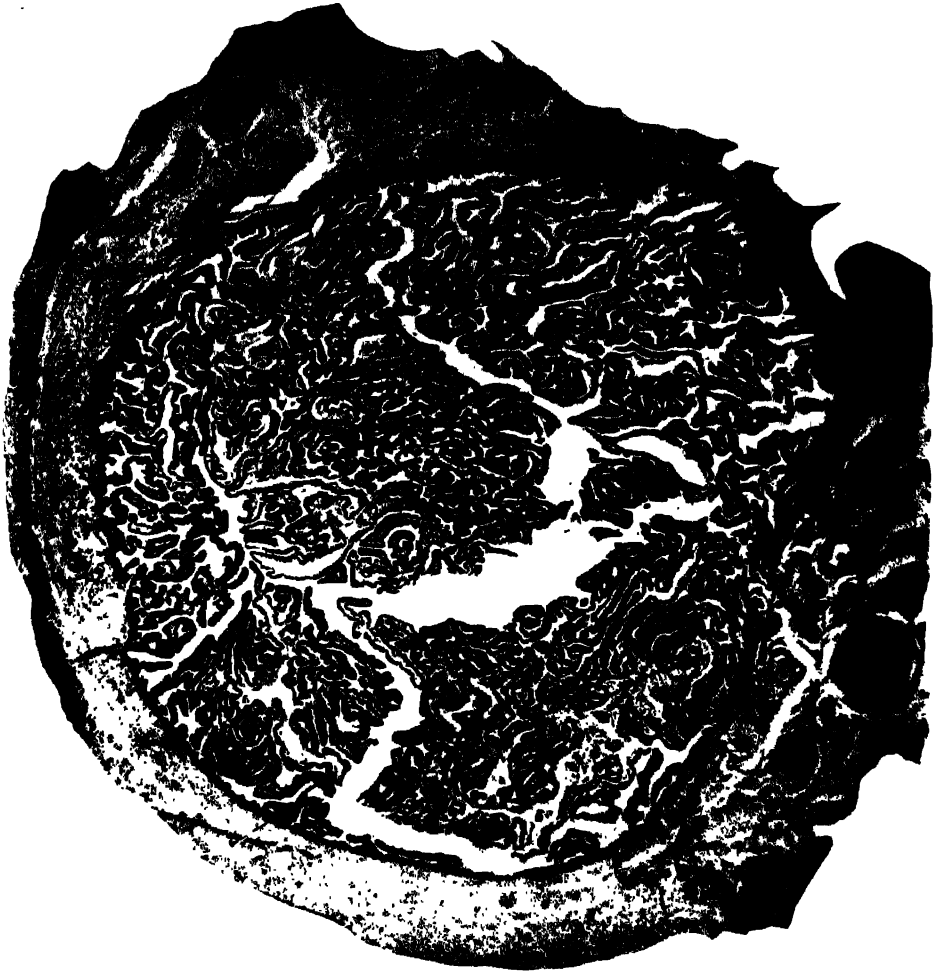
Fig. 100.—Section of the tube near the outer end. The extensive longitudinal folding of the mucosa produces the spaces that give the glandlike appearance in the section. In this mass of delicate folds inflammation would quickly cause disorganization. The intricacy of the folds in the normal tube is well shown in this photomicrograph. Gyn. Lab.

outer portion of the tube (the ampulla) they become very complex and fill the tube with folds extending in every direction (Fig. 100)—so much so that it is sometimes difficult to decide which is the main canal of the tube. The cilia of the epithelium project into the lumen of the tube and by their movement toward the uterus aid the passage of the ovum in that direction. In the presence of this delicate and much-folded mucous membrane, inflammation in the tube quickly causes serious changes. The cilia are lost, the folds become adher-

ent, pockets of serum or pus form, and the picture of the tubal interior may be so changed as to be hardly recognizable.

Vessels and Nerves.—The blood supply of the tube comes from the ovarian artery through several small branches. The uterine artery helps to supply the tube in some cases. The veins open into the pampiniform or ovarian plexus and pass into the broad ligament. The lymphatics join with those from the ovary. The nerve supply comes from the pelvic plexus of each side.
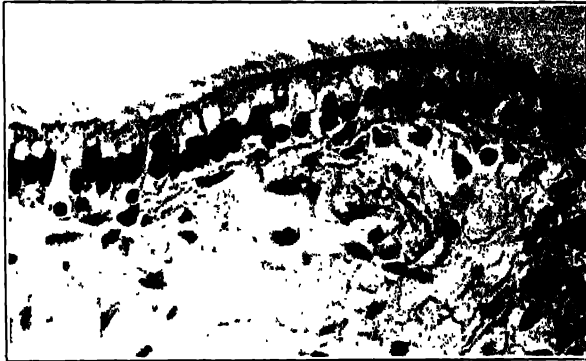
Fig. 101.—Fimbriated end of the tube. Showing the epithelium consisting almost entirely of ciliated columnar cells. (Novak—Am. J. Obst. and Gynec.)

Fig. 102.—Normal postmenstrual tubal epithelium showing ciliated, nonsecretory cells (*C*), nonciliated, secretory cells (*S*), and peg cells (*P*). (Novak—Am. J. Obst. & Gynec.)

PHYSIOLOGY

of the Tubes

The primary function of the fallopian tube of each side is to convey ova from the corresponding ovary to the uterus. It is supposed to require several days for the ovum to pass the length of the tube. In addition to this, the tube conveys spermatozoa in the opposite direction, and it is usually in the tube that the union of the ovum and the spermatozoon takes place.

The mechanism by which the ovum is carried from the ovary into the tube is complicated. After the graafian follicle in the ovary bursts, the liquor folliculi causes the ovum to adhere slightly to the surface of the ovary. Some of the fimbriae are in contact with the surface of the ovary and, when an ovum comes into contact with one of them, the cilia carry it toward the entrance of the tube. The developmental adaptation of epithelium to the particular function it is to perform is well seen in the tubal fimbriae, in which practically

Fig. 103.—Tubal mucosa growth stage. The cells are all about the same height. Secretory cells are seen at *C*, ciliated cells at *B*, and straight rod cells at *A*. Gyn. Lab.
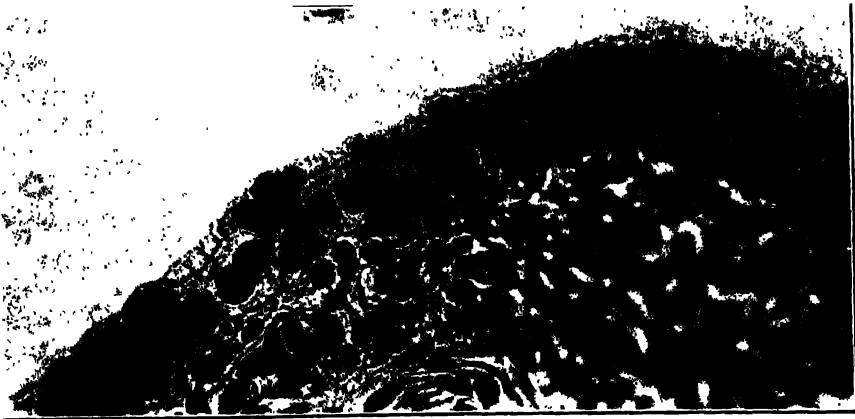
Fig. 104.—Tubal mucosa, premenstrual phase. The marked irregularity in height is clearly seen; the nonciliated secretory cells, seen at *A*, are much higher than the ciliated nonsecretory cells seen at *B*. The three secretory cells clustered together at *A* show partially extruded nuclei with their rounded surface toward the tubal lumen. Gyn. Lab.

all the cells are ciliated (Fig. 101) instead of being of the mixed variety seen in the intratubal mucosa. Besides this action of the cilia directly on the ovum, the constant movement of all the cilia causes a slight current of peritoneal fluid toward the interior of the tube from all directions. This helps to carry the ovum or any other particles into the tube. The fact that there is such a current toward the interior of the tube has been demonstrated in animals by

the injection into the pelvic peritoneal cavity of numerous small insoluble particles, which were found later in the tubes.

Cyclic variations in the intratubal pressure, interpreted as peristaltic contractions, have been shown experimentally in a sow's fallopian tube. These are controlled by estrin and progestin in the blood.

Kymographic records of Rubin tests made on human beings show similar variations, which are interpreted by Rubin as evidence of peristaltic contractions of the tube. We have observed what appeared to be peristalsis under the fluoroscope during a hysterosalpingogram. The rate of contractions varies at different times in the cycle, contractions being most frequent just before and after ovulation and least frequent about the time of menstruation.

Westman studied tubal movements by injecting a drop of lipiodol under the peritoneal sheath of the end of the tube and then tracing its movement by x-ray films and found that the fimbriated end of the tube covers the ovarian surface at the time of ovulation. This is evidently an important factor in aiding the ovum to pass into the tube instead of being lost in the peritoneal cavity.

Normal Changes in the Tubal Epithelium

In studying the physiology of the uterus it was found that this organ, particularly the mucosa, was subjected to normal changes under three conditions: namely, menstruation, pregnancy, and the menopause. Now, in the fallopian tube also, we find normal changes, due to menstruation, to pregnancy, and to the menopause. Speaking generally, it may be said that these changes are like those occurring in the uterus, but less marked.

During **menstruation** there is congestion of the tube and possibly a slight effusion of blood into the interior of the tube. If this does take place, however, it is slight and is of no importance when considering the source of the menstrual blood. Practically all of the menstrual blood comes from the uterus. In a case of removal of the uterus by operation and the fastening of one of the tubes in the vaginal incision, a slight bloody flow was noticed at the menstrual periods for a few months. But such tubes are pathologic, and it is an open question whether or not bloody flow would take place from a normal tube.

The tubal epithelium contains two types of cells: the ciliated or nonsecretory, and the nonciliated or secretory.

The epithelium of the tubes also goes through cyclic changes during the menstrual cycle. The following stages have been described by Novak and Everett:

1. Postmenstrual stage (Fig. 102) in which the epithelium is low at first but rapidly increases in height, so that by the third or fourth day after menstruation it is almost as tall as during the interval. The cells are narrow, closely packed, and, after the first day or so, of uniform height.

2. In the growth phase (Fig. 103) the epithelium is uniformly tall, the ciliated cells being broad, with rounded nuclei near the free margin. The nonciliated cells are narrower and the nuclei are deeply placed.

3. In the premenstrual phase (Fig. 104) the ciliated cells become lower, so that the secretory cells project beyond them, giving the margin a ragged appearance. The secretory cells show a bulbous herniation into the lumen of the tube, often carrying the nucleus with it. Mitoses are rarely seen.

4. During the stage of menstruation the epithelium becomes quite low. The secretory cells, having emptied out into the lumen, are very low, and frequently the nucleus is quite bare of cytoplasm.

Novak, in an instructive article on the different types of genital epithelium and their occasional variability, emphasizes the strategic position of the fallopian tube in this segmental development of the original coelomic epithelium to different functions in the different parts of the tract.

PELVIC PERITONEUM

The pelvic peritoneum is that portion of the wall of the peritoneal sac which lies in the pelvis. It is attached more or less closely to the pelvic organs, and its free surface comes in contact with the peritoneal surface of the intestines as they move about in the lower abdomen. To get an idea of the distribution of the peritoneum in the pelvis, imagine a piece of thin cloth laid over the pelvic organs and tucked down firmly around them (Fig. 64).

Starting from the abdominal wall, the peritoneum passes on to the bladder, and from the posterior surface of the bladder to the uterus. The height of the abdominovesical fold of peritoneum varies much with the varying size of the bladder, which fact is of great importance in surgical work. The distance to which the peritoneum extends down the anterior surface of the uterus varies considerably in different persons. Usually it extends to the level of the internal os and is about an inch above the anterior vaginal fornix. When the bladder is distended, the peritoneum is drawn upward somewhat. This vesicouterine fold of peritoneum forms the two so-called "vesico-uterine ligaments."

The peritoneum then folds over the uterus and tubes and round ligaments, covering these structures and forming the "broad ligament" of each side. All the posterior surface of the uterus is covered with peritoneum, except that portion lying within the vagina. The fold of peritoneum extends a considerable distance below the point of attachment of the vagina to the uterus (Figs. 2 and 65) before being reflected on to the rectum. The deep pouch of peritoneum thus formed is called the "cul-de-sac of Douglas." It is known also as the "posterior cul-de-sac" and as the "posterior peritoneal pouch" and as the "recto-uterine pouch." This posterior cul-de-sac is very important surgically. A collection of exudate or a tumor in this situation can be easily felt from the posterior vaginal fornix. This is the point of incision in posterior vaginal section.

The peritoneum, as it is reflected from the uterus to the rectum, helps to form the "sacro-uterine ligaments." The sacro-uterine ligaments, two in number, one on each side, extend backward from the lower part of the uterus around the rectum to the sacrum. They are composed of connective tissue, a few muscular fibers, and peritoneum. The cul-de-sac of Douglas dips down between them for a considerable distance (Fig. 64). The expanse of peritoneum extending from the sacroiliac ligament to the broad ligament of each side forms a kind of shelf. The two together are sometimes called the "recto-uterine shelves." There is also a fold or shallow pouch of peritoneum on each side between the fallopian tube and the round ligament. A small portion of the uterus at the sides and in front is not covered with peritoneum (Fig. 65).

The structure of the pelvic peritoneum is much the same as of peritoneum elsewhere. It is a very thin and smooth membrane, formed of a basis of delicate fibrous and elastic tissue, supporting large endothelial cells.

PELVIC CONNECTIVE TISSUE

The strong fascial layers of the musculofibrous sling, or diaphragm, closing the pelvic outlet are shown in Chapter V. This supporting diaphragm is formed by the levator muscles and the fascia above and below, the upper being known as the pelvic fascia and the lower as the obturator fascia, as well as by other names. Between the peritoneum and the well-marked pelvic fascia there is a large amount of loose connective tissue distributed so as to fill the spaces between the organs. This connective tissue is designated as the endopelvic fascia. Where it is necessary for the organs to change their relations to each other in physiologic activity, the connection is open and loose to permit of free movement. The principal collections of connective tissue are at the sides of and in front of the cervix uteri and at the base of each broad ligament. The tissue also runs up the sides of the uterus between the peritoneal layers, as shown in Fig. 105.

The areas of connective tissue are exceedingly rich in lymphatics and veins. Inflammation taking place in this connective tissue is called "pelvic cellulitis." The connective tissue about the uterus is often spoken of as the "parametrium" or parametrial tissue, and inflammation of it is accordingly called "parametritis." In the beginning of gynecologic work it was supposed that nearly all inflammation in the pelvis outside the uterus was inflammation of the connective tissue (i.e., pelvic cellulitis), but it was soon found that in the majority of cases of an inflammatory mass in the pelvis (particularly in gonorrheal inflammation) the process extended from the uterine cavity to the tube and then to the peritoneum. In such cases, if there is connective tissue involvement at all, it is usually a late development and of only secondary importance. There are exceptions to this rule; for example, those inflammatory conditions resulting from tears of the cervix or from operation on the cervix, or from puerperal infection (staphylococcic, streptococcic). In such cases the inflammation extends directly through the wall of the uterus into the pelvic connective tissue.

The connective tissue between the pelvic organs has been the subject of considerable controversy among those who have specially investigated it, the difference being as to whether it normally presents condensations forming distinct fascial sheets between the organs or only loose areolar connective tissue. Evidence pro and con will be found in the articles by Goff, by Curtis, Anson and Beaton, and those by Koster, Hurd, Sears, Hornaday. The matter is not so easy to settle as might appear at first thought. The following factors complicate the problem of deciding what is normal anatomy in this respect: 1. Prolapse cases, on which most operative work involving these tissues is carried out, are not normal but pathological, and the tendency of the prolapse-drag on areas of loose connective tissue would seem to be to produce lines of tension and condensation resulting in the condensed sheets or fascial planes so often found in such cases. 2. As will be seen in the literature mentioned,

careful investigation of normal pelves by microscopic study of cross sections of the urethrovaginal and vesicovaginal and rectovaginal septa failed to show evidence of such sheetlike condensations. 3. In the dissection of loose connective tissue it is difficult to avoid artifacts giving the impression of such sheetlike planes of condensed tissue. Demonstration of microscopic cross sections of undisturbed portions of the septa, along with regular dissections of other portions of the same septa, would assist in arriving at a decision in the matter. 4. The difficulty in securing employment of uniform and clearly understood terms for the different portions of the pelvic connective tissue is aggravated by a secondary meaning attached to the word "fascia."
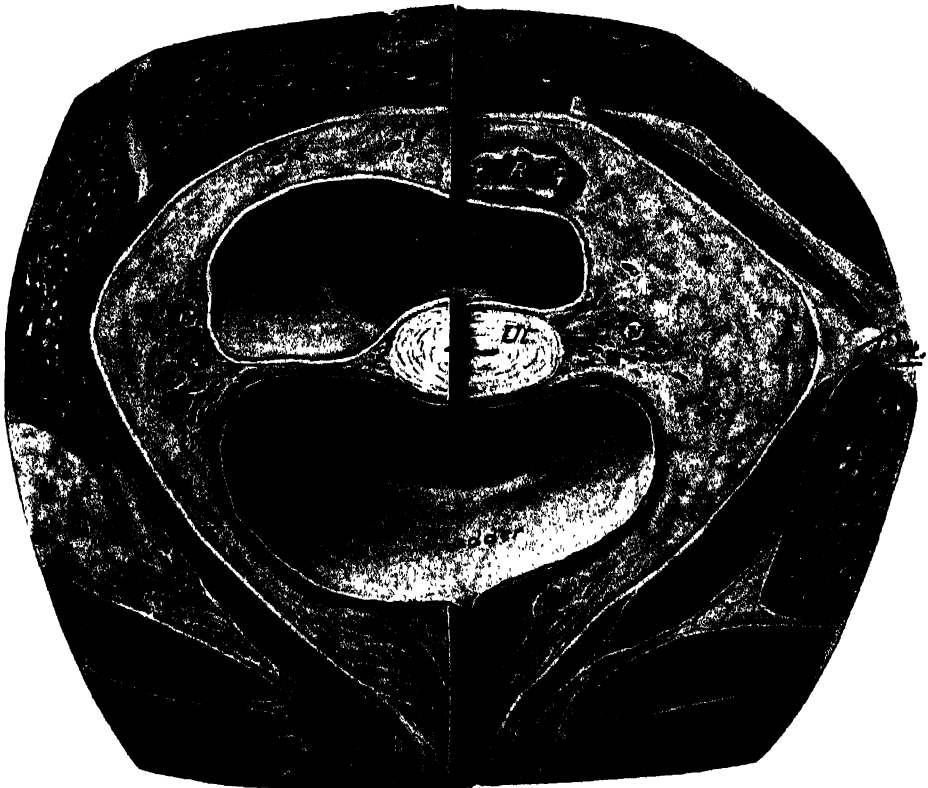
Fig. 105.—Diagrammatic representation of the connective tissue areas in the pelvis at different levels. Left side of pelvis—section through cervix, showing the large area of connective tissue at side of cervix. Right side of pelvis—section at higher level, showing how the broad ligament becomes thinned, leaving only a small amount of connective tissue at side of corpus uteri.

As ordinarily understood, a fascia or fascial layer is a firm, condensed sheet of connective tissue, in contradistinction to the other kind which is loose areolar connective tissue. In addition to this primary and well-understood meaning of the word, the term is used by anatomists to designate also loose, areolar connective tissue. This secondary use of the term leads to misunderstanding and confusion, as may be seen by perusal of the literature of this controversy, and there seems little chance of a clarification of the matter as long as this term is used to designate two diametrically opposed types of structure. For anatomical knowledge and nomenclature we naturally depend

on the anatomists, who make a lifetime study of the subject. A welcome aid toward uniform and generally understood designations in this matter would be to limit the term fascia to a condensed sheet of connective tissue, and designate loose areolar connective tissue as areolar connective tissue.

VAGINA

The vagina is a musculomembranous canal extending from the vulva to the neck of the uterus, around which it is attached. It lies between the bladder and the rectum as shown in Fig. 2.

Its **size** and **shape** are variable and it is capable of great distention, as is seen when the child passes through it in labor. The length of the vagina is ordinarily three to four inches along its anterior wall, and five to six inches along its posterior wall (Fig. 106). It is constricted at its lower end, where it is partially closed by the hymen, and it becomes dilated toward the uterine extremity.
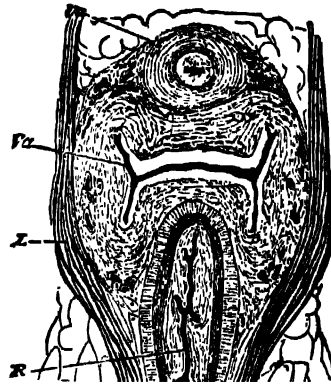
Fig. 106.   Fig. 107.

Fig. 106.—Longitudinal section of vagina. (Skene—*Diseases of Women*, D. Appleton-Century Company.)

Fig. 107.—Cross-section of the pelvic structures, showing the relations of the urethra, vagina, rectum, and levator ani muscles. Notice how the vaginal walls fold so that the shape of the cavity approximates the letter H. *Ur*, urethra; *Va*, vagina; *R*, rectum; *L*, levator ani muscle. (Savage—*Anatomy of Pelvic Organs.*)

Normally, the anterior and posterior vaginal walls lie in contact, and on cross-section the **cavity** is represented by a slit having somewhat the shape of the letter H (Fig. 107). The wide diameter of the vagina, some distance up the canal, is the transverse diameter, but the wide diameter of the vulvar cleft is the anteroposterior diameter. Furthermore, the anterior end of the vagina lies so far up in the narrow part of the pubic arch (in patients where the perineum has not been damaged) that there is not much room laterally. Consequently, in introducing the speculum, the preferable way is to introduce one finger into the vaginal opening and press the perineum well back, so that the vaginal opening is stretched anteroposteriorly and made to correspond in a measure with the vulvar cleft, and then introduce the speculum obliquely as shown in Chapter II. When the speculum is well past the entrance, so that it may be used to depress the perineum, it is then turned with its width in the transverse diameter of the vaginal canal and introduced all the way.

Relations.—Fig. 106 shows the angle which the axis of the uterus normally bears to the axis of the vagina. The upper end of the vagina surrounds the lower end of the uterus. That portion of the cervix uteri projecting into the vagina is known as the vaginal portion (portio vaginalis). The attachment of the
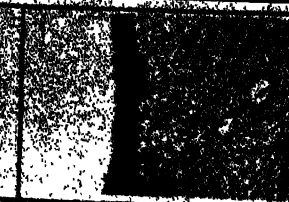
	Newborn	Month old Child	Puberty	Sex-Mature	Post-Menopause
Estrogenic hormone	+	−	appears	+	−
Epithelium					
Glycogen	+	−	− to +	+	−
Acidity	acid pH 4-5	alkaline pH 7	alkaline → acid	acid pH 4.5	alkaline pH 6?
Flora	sterile? Döderlein's bac. (secretion abundant)	sparse, coccal and varied flora (secretion scant)	sparse, coccal → rich bacillary	Döderlein's bacilli (secretion abundant)	varied flora (secretion scant)

Fig. 108.—The changes in the vaginal epithelial covering at different ages, showing the dominant role of estrogen in the control of the biology of the vagina and of the character of its mucosa. (Davis and Pearl—Am. J. Obst. & Gynec.)

vagina extends higher on the posterior wall of the cervix than on the anterior. The vaginal mucosa is continued on the cervix as far as the external os.

The upper end of the vagina is termed the "vaginal vault." The term "fornix" is also much used, the anterior fornix being that portion of the vault in front of the cervix, and the posterior fornix being that portion lying

behind the cervix, and the right and left lateral fornices lying to the right and left respectively. With the uterus in normal position, the posterior fornix is much deeper than the anterior, for the vaginal wall is attached higher on the posterior surface of the cervix than on the anterior.

The vagina is surrounded by important structures. The anterior wall is in contact with the urethra and the base of the bladder. The vaginal wall and bladder wall and the tissue lying between them constitute the vesicovaginal septum. The posterior wall for the lower three-fourths of its extent is attached to the anterior wall of the rectum, except for the very lowest portion, which is separated from the rectal wall by the perineum. The vaginal and rectal walls and the tissue lying between them constitute the rectovaginal septum. The upper fourth of the posterior wall is separated from the rectum by the recto-uterine pouch of peritoneum, known as the "cul-de-sac of Douglas." The sides of the vagina give attachment to fibers from the levator ani muscles and the rectovesical fascia.

The wall of the vagina presents three layers: an external connective tissue layer, a middle muscular layer, and an inner mucous layer.

The CONNECTIVE TISSUE layer serves to attach the vagina to the adjacent organs. It contains the external plexus of veins, and is composed of connective tissue filled with lymphatics and blood vessels, the veins being especially numerous. The attachment of the vagina anteriorly is firm in the lower third where it is attached to the urethra. It is more loosely attached to the bladder in the middle and upper third, particularly the latter, and is easily separated in operating.

The MUSCULAR LAYER contains involuntary muscle fibers arranged in bundles without distinct strata. Some of the bundles are longitudinal, some transverse, and some oblique. The muscular layer is thicker at the lower than at the upper end.

The MUCOUS LAYER, or lining of the vagina, presents on the surface a thick squamous epithelium of many layers (Fig. 108), with the usual basal layer just above the connective tissue. The vagina normally contains no glands. The secretion found in the vagina comes from the cervix and the endometrium, principally the former. The vaginal walls are kept constantly moist with the secretion, and consequently the epithelium desquamates before it advances so far in the process of cornification as is seen in integument. In cases of prolapse, where the vagina is turned outside the vulva and is subjected to friction of the clothing and is kept dry by contact with them, it becomes more like ordinary epidermis and shows well-marked keratin changes. The mucosa (epithelium and connective tissue immediately under it) is attached to the muscular coat by a submucous layer of loose connective tissue which is very rich in interlacing veins, about some of which are bundles of muscular fibers, forming a kind of cavernous tissue.

The vaginal mucosa is thrown into numerous large folds called "rugae." Extending longitudinally along both the anterior and the posterior wall of the vagina is a prominent ridge, best marked in the virgin. These ridges are known as the "columns" of the vagina, and from them the rugae extend laterally. The columns and rugae becomes more or less obliterated by childbirth, so that in many multiparae the vagina walls are almost smooth.

Vessels and Nerves.—The blood supply of the vagina comes from the anterior trunk of the internal iliac, through the vaginal, uterine, middle hemorrhoidal, and internal pubic arteries. These anastomose freely in the vaginal wall. The veins of the vagina are arranged principally in two plexuses that form complete sheaths around the canal. One plexus is external to the muscular layer, while the other lies just beneath the mucosa. These veins form an intricate network and communicate freely with the plexus of the other organs and with the plexus of the broad ligament.

The lymphatics from the lower third of the vagina, it is generally held, join those from the external genitals and empty into the inguinal glands. But Poirer, who has made a special study of the subject, claims that all the lymphatics of the vagina empty into the pelvic glands and that when an injection of the vaginal lymphatics is made, even just within the hymen, no injection material passes to the inguinal glands except through some anastomosing channels. The lymphatics from the middle third of the vagina empty into the hypogastric glands. Those from the upper third join with the lymphatics of the cervix uteri and pass to the iliac glands.

The NERVE SUPPLY of the vagina comes from the pelvic plexus of each side.

PHYSIOLOGIC CHANGES
in the Vagina

Studies in the cyclic changes of the vaginal epithelium in the human being and in the monkey point to the fact that these changes are under the control of the ovarian hormones.

Dierks, from a study of vaginal biopsies in women at various times in the menstrual cycle, concluded that the relationship of the three epithelial layers of the vaginal epithelium varied at different times in the period. The vaginal epithelium is composed of three layers: a basal layer, a functional layer, and a cornification or intra-epithelial layer.

Immediately after menstruation there is an increase in the functional layer and a marked proliferation of the basal layer so that this latter becomes many layers thick. Numerous mitoses can be seen in the basal layer. Near the middle of the cycle or about the time of ovulation a layer of new cells is formed between the basal layer and the functional layer. This layer was described by Dierks as the intra-epithelial cornified zone. The cells in this layer contain granules and the nuclei are small and dark staining. With the onset of the menses the functional and the intra-epithelial layers are destroyed and cast off, leaving the basalis layer completely denuded at the end of menstruation. There are some dissenting views as to the presence of this cycle, but this work has been confirmed by Keller, Pankow, Geist, and Papanicolaou. Papanicolaou has followed the cyclic changes by the vaginal smear technique in twelve women and feels that he can tell the time of ovulation and diagnose early pregnancy with a fair degree of accuracy. When enough work has been done to correlate and standardize the findings, this may prove to be a very valuable aid in diagnosis.

In young girls before puberty the vaginal epithelium consists of an inactive basal layer three or four cells deep. There is no glycogen in these cells during
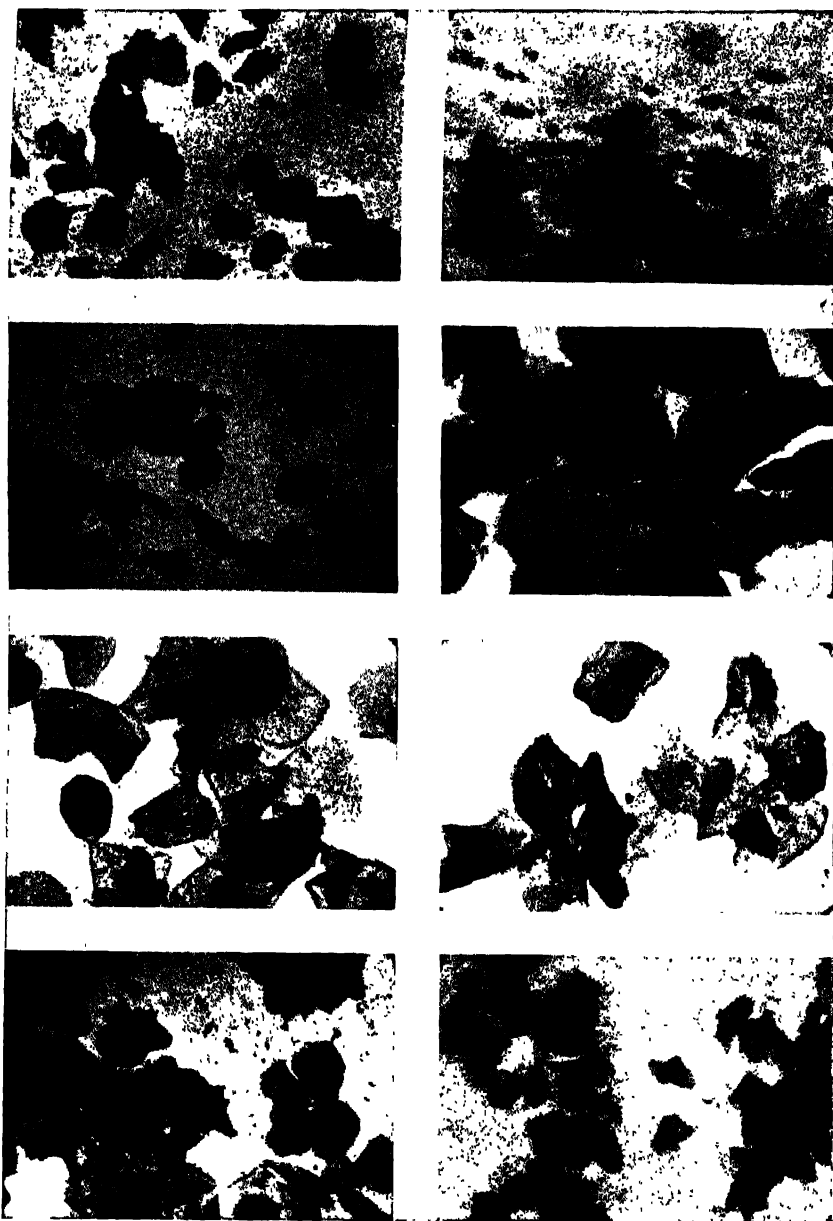
Fig. 109.—Vaginal smears during the normal menstrual cycle. (Papanicolaou stain.)

a, (80×.) Postmenstrual smear, cell Types I and II, indicative of an early estrogen effect. *b*, (160×.) Postmenstrual smear, cell Types II and III, with an occasional Type I. Note presence of leucocytes in mucous strands. This smear indicates some increasing estrogen effect. *c*, (80×.) Preovulative smear, cell Types II, III, and IV, indicative of a high level of estrogen. *d*, (100×.) Ovulative smear. Cell Types III and IV indicate nearly maximal estrogen effect on vaginal mucosa. *e*, (160×.) Postovulative smear. Cell Types III, IV as above, and Type V, indicate minimal progesterone action—the typical folding and curling of the cell edges. *f*, (100×.) Smear of luteal phase. Cell Types V and VI indicate prolonged progesterone action. The folding and curling are present even in these less cornified cells from deeper vaginal layers. *g*, (80×.) Same as above. Note the extensive desquamation and aggregation indicating the action of both estrogen and progesterone on the vaginal mucosa. Note also that leucocytes are present. *h*, (80×.) Premenstrual smear. Cell Types V, VI, VII and I. The presence of Type VII, cell debris is typical of the premenstrual phase; the smear is "dirty," the cell and nuclear outlines are indistinct although nuclear size and granularity of cytoplasm indicate that these cells are frequently from deep layers of the vaginal mucosa. (Rubenstein— *Endocrinology.*)
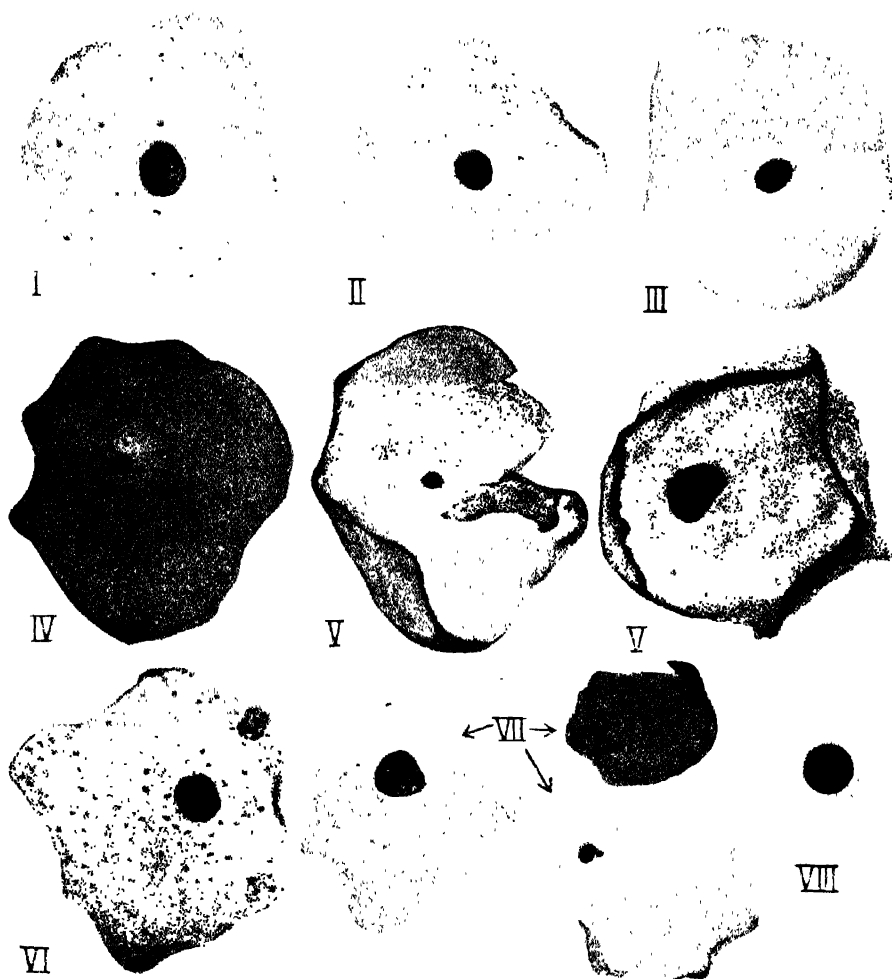
FIG. 110.—TYPES OF VAGINAL EPITHELIAL CELLS FOUND IN VAGINAL SMEARS.

These represent only types described in the classification. Intermediate types are also always present but should easily be recognized as such.

On the opposite page, the significance of these cell types in regard to estrogen effect and also in relation to the stages of the ovulation cycle, is illustrated by vaginal smears and described in the legends. (Rubenstein—*Endocrinology*.)

this period. With the onset of puberty the three layers are promptly established, and glycogen appears in the cells. After the menopause the vaginal epithelium returns to the prepuberty state with no glycogen in the cells and a basal layer of only two or three layers. In the newborn child some of the maternal estrin is still present and, as would be expected, glycogen is found in the vaginal epithelial cells for three or four weeks after birth. The mature epithelium can be produced in the prepuberty girls by theelin administration.

The variations in the mucosa of the vagina at different ages were studied by Davis and Pearl, and Fig. 108, presenting these changes from birth to old age, is from their article. These changes in the vaginal epithelium are presented in detail by Rubenstein, as shown in Figs. 109 and 110.

Cruickshank and Sharman found that the appearance of the Doederlein's bacillus and an acid vaginal secretion were coincident in time with the presence of glycogen in the vaginal epithelium, and they believe that the production of the acid reaction is a defense mechanism against harmful bacteria. Early in pregnancy this reaction is absent, but it develops in the later months.

Davis and Hartman summarize the similar changes found in the monkey as follows:

"The cyclic changes in the vaginal epithelium were studied in a large group of female monkeys at the Carnegie Monkey Colony by means of frequent biopsies. These rhythmic changes were coordinated with ovarian activity and ovulation.

"We found that the epithelium attains its greatest thickness in the mid-interval, consisting at this time of an active basal layer, an inactive functional layer, and an intra-epithelial zone of cornification interposed between these two, which we call Dierks' layer. Following ovulation, desquamation begins and proceeds by a crumbling away of the functionalis, which is usually not completely destroyed. Mitosis begins in the basalis on the first day of menstruation, becoming most marked near the time of ovulation, and then gradually subsides.

"A cessation of ovarian activity, such as is seen at the menopause, or an abnormal ovarian activity, definitely alters these physiologic changes.

"Early in pregnancy the epithelium remains in the same state as is seen during ovulation, consisting of the typical three layers.

"Desquamation of the functional layer continues throughout pregnancy but is increased progressively following the middle of pregnancy.

"At the end of pregnancy only the basalis remains and is of irregular thickness, in many places of only three or four cells."

The vaginal epithelium in the human being undergoes changes similar to those described by Davis and Hartman in the monkey. Recently these changes were described in detail by Rubenstein, and the colored illustration showing types of cells (Fig. 110) and also Fig. 109 are from his article.

Estrogen stimulates proliferation of the vaginal epithelium so that it becomes many layers thick, and as the thickness increases the superficial cells are pushed farther and farther from their blood supply and hence they degenerate and become cornified. At various stages of this process typical cells appear in the vaginal smears, as described in the legends of the above-mentioned illustrations.

EXTERNAL GENITALS

The external genitals (Figs. 111 to 115), called also the vulva and the pudenda, include the following structures:

Mons Veneris	Vestibule
Labia Majora	Vulvovaginal Glands
Labia Minora	Hymen
Clitoris	

The **mons veneris** is simply a pad of subcutaneous fat lying over the symphysis pubis. The triangular area which it forms is covered with hair

Fig. 111.

Fig. 112.

Fig. 111.—External genitals of a virgin. Photograph from a cadaver. (Dickinson—*American Textbook of Obstetrics.*)

Fig. 112.—Diagrammatic representation of the external genitals of a virgin. (Dickinson—*American Textbook of Obstetrics.*)

after puberty. The upper margin is the base of the triangle and is often marked by a slight transverse crease due to bending of the abdominal wall in exercise. The sides are formed by the inguinal creases, which run downward and inward toward the pubes, making the lower pointed portion of the triangle, which is continuous with the labia majora. Examination of a microscopic section through this region shows the usual characteristics of skin, i.e., many layers of squamous epithelial cells (the deepest being cubical and the most superficial being flattened and horny) placed on loose connective tissue, and presenting hairs, sebaceous glands, and sweat glands. A little deeper there is much fat,

which is penetrated and held together by fibrous septa that divide it into lobules. There are also many elastic fibers.

The **labia majora** (Fig. 113) are two cutaneous folds which extend, one on each side, around the vaginal opening. They are apparently continuations of the mons veneris and, passing backward, end by joining the perineum. The external surface of each labium majus presents the ordinary characteristics of integument. Each labium is limited externally by the genitocrural folds and corresponds to that side of the scrotum in the male. The round ligament, coming through the inguinal canal of each side, terminates in the upper part of the labium majus of that side. Sometimes a distinct canal remains open for some
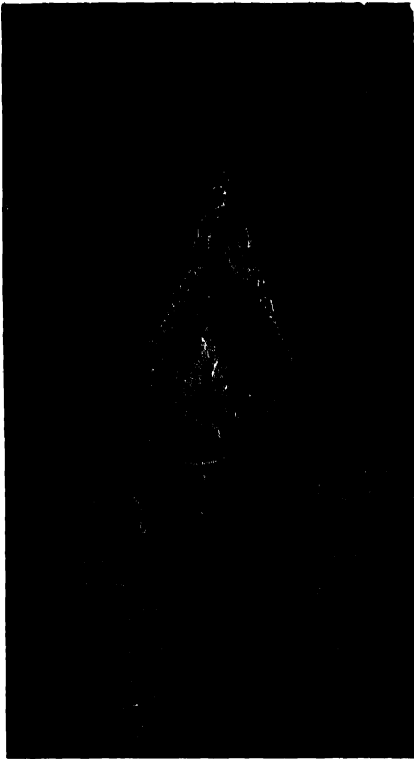
<table>
<tr><td>Fig. 113.</td><td>Fig. 114.</td></tr>
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Fig. 113.—External genitals of a married woman. (Dickinson—*American Textbook of Obstetrics*.)

Fig. 114.—External genitals of a multipara, with slight perineal laceration. (Dickinson—*American Textbook of Obstetrics*.)

distance along the round ligament. This is known as the canal of Nuck, and through it a hernia may take place into the labium, constituting a labial hernia. This is known also as a pudendal hernia. The hernial contents may be intestine or omentum or ovary or even the uterus. Occasionally the canal of Nuck is shut off from the peritoneal cavity, and the sac thus formed fills with fluid, giving rise to pudendal hydrocele or "hydrocele of the canal of Nuck." The inner surface of each labium majus is smooth and of a pinkish color. It has largely lost one of the characteristics of integument—the hairs—only a few fine hairs being found here.

In children the labia majora are very small and the labia minora project between them. As puberty is approached the external labia become larger and meet in the median line. At puberty they, in common with the mons veneris, become covered with hair. A little later in life, particularly in married women, the labia minora become enlarged so much that they project forward, separating the labia majora. In old age the labia undergo marked diminution in size and prominence, the shrinking being due largely to absorption of the fat.

Microscopic examination of a section of a labium majus shows the same structures found in the mons veneris, the only difference being that on the inner surface of the labium there are only a few hairs, and they are small. There are, however, many sebaceous glands. There are also, of course, the arteries, veins, and other structures found in cutaneous and subcutaneous tissues. The connective tissue is rich in elastic fibers, and still deeper there is the thick deposit of fat that gives the labium its prominence. The veins are numerous and large, and become much distended when there is intra-pelvic pressure, as in pregnancy or from a tumor. Under such circumstances, a wound of the labium may lead to serious and even fatal hemorrhage.

The **labia minora** (Fig. 113), or nymphae, are two delicate mucocutaneous folds lying between the labia majora, one on each side of the vaginal opening. Each labium minus apparently grows from, or is a secondary fold of, the upper and inner portion of the labium majus of that side. In stout women the nymphae are normally concealed by the labia majora. Ordinarily, particularly in married women, they project slightly. Frequently they are somewhat en-larged and project half an inch or more. The enlargement is usually not exactly symmetrical, and in some cases it is confined to one labium. In a valu-able article on these enlargements of the labia minora, Dickinson upholds the idea that whenever the enlargement is marked, it is proof of excessive irrita-tion of the labium. It is stated that among the Hottentots, owing to certain treatment practiced in childhood, the labia minora often become excessively developed and hang like a thick apron between the thighs. The labia minora begin just below the anterior junction of the labia majora as double folds which pass above and below the clitoris. The folds that join above the clitoris form the prepuce of the same. The labium minus of each side then descends along the inner side of the labium majus and blends with labium majus about the junction of the middle and lower third. The posterior extremities of the labia minora are united by a delicate fold which extends between them just within the posterior margin of the vulvar orifice, forming the fourchette. When the labia are separated, the fourchette is made tense, and between it and the hymen is a small depression called, from its boatlike shape, the "fossa navicularis." This delicate fourchette is, except in rare cases, torn at childbirth, and in some cases is obliterated even by sexual intercourse. It is best seen in the virgin.

There has been dispute as to whether the inner surfaces of the labia minora are covered by integument or mucous membrane. The covering presents some of the characteristics of each. It is a transitional form of covering and repre-sents one step in the several changes which take place from the labia majora to the external surface of the cervix. The outer surfaces of the labia majora are ordinary integument. On the inner surfaces of the same structures, the

Urethral orifice

Vestibule

Hymen

Vagina

Greater vestibular
gland (Bartholin)

Fossa navicularis

Urogenital trigone

Bulbocavernous M.

Perineal body

Transv. perineal M.
(Superficial)

Levator ani M.

Ext. sphincter ani M.

dorsal artery
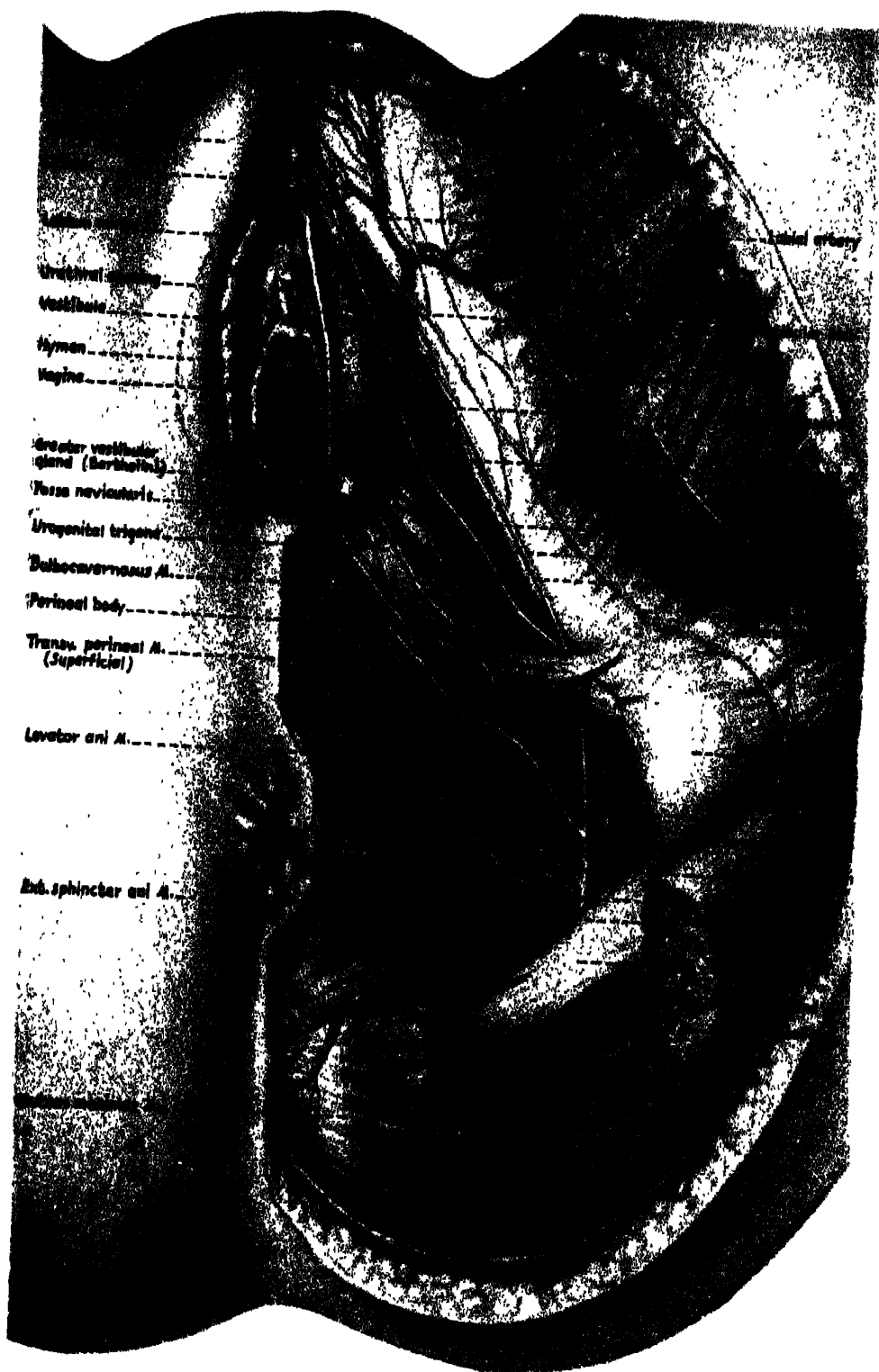
FIG. 115.—THE EXTERNAL GENITALS, WITH BLOOD SUPPLY AND NERVE SUPPLY. (Modified from
Savage, Spalteholz, Sobotta.)

hairs are much reduced in size and number. On the labia minora, the hairs are absent, though the sebaceous glands are still present. On the vestibule, only a few glands remain, and the thinning of the epithelium is more marked. In the vagina, all glands disappear (it being now generally held that there are no glands in the normal vagina) and the epithelium becomes thinner and the papillae less marked. Over the vaginal portion of the cervix the papillae have almost disappeared. So there is a gradual transition from ordinary integument, with a thick epithelial layer, hairs, sebaceous glands, sweat glands, and marked papillae, to a thin epithelial layer without hairs or glands and almost without papillae. When the vaginal wall is turned out for a long time, as in

Fig. 116.   Fig. 117.

Fig. 116.—Section of vulvovaginal gland showing duct and gland acini. Low power. (Cullen—*J. A. M. A.*)
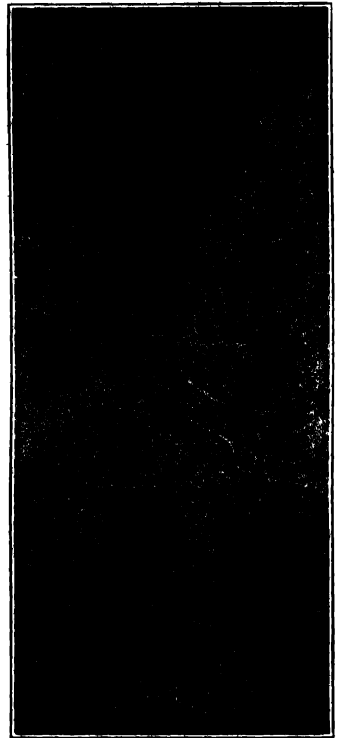
Fig. 117.—Section of vulvovaginal gland showing acini and lining cells. High power. Gyn. Lab.

prolapse, and exposed to friction by the clothing, the epithelial layer becomes much thickened, and if the surface is kept dry, it becomes horny like the external integument.

The labia minora have many small folds, giving a very uneven surface. Examination of a section of a labium minus shows numerous epithelial depressions, owing to the much folded surface. The bands and nests of epithelial cells seen in such a section are simply oblique cuts of normal folds and ingrowths. The labia minora are very rich in blood vessels, especially veins, so much so that the structure partakes of the nature of erectile tissue. They are also rich in lymphatics and nerves.

The **clitoris** is the analogue of the penis in the male, and is situated just below the anterior junction of the labia majora. It is a small erectile organ richly supplied with blood and nerves, and is attached to the sides of the pubic arch by its crura. In both the clitoris and the labia minora there are special nerve endings. Examination of a section of the clitoris shows the erectile nature of the structure. During sexual excitement the clitoris fills with blood and becomes swollen and firmer. It is supposed to be the most sensitive of all the genital organs to sexual contact, and on this account excision of the clitoris (clitoridectomy) was proposed and carried out for the relief of disturbances depending on sexual hyperesthesia, but the results were not such as to recommend the operation, and it is now rarely practiced.

The **vestibule** is an elliptical area situated between the labia minora. The sides are formed by the labia minora, the anterior end extends to the clitoris, and the posterior end is formed by the junction of the labia majora. Into this
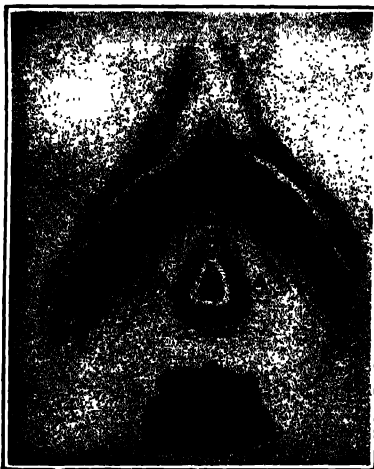
Fig. 118.

Fig. 119.

Fig. 118.—Indicating the line of division of the urethra to give the view shown in Fig. 119. (Dudley—*Practice of Gynecology*, Lea and Febiger.)

Fig. 119.—The urethra divided so as to show the openings of Skene's glands. The openings are situated just within the meatus, one on each side. (Dudley.)

vestibule four canals open—the urethra, the vagina, and the duct of the vulvo-vaginal gland of each side. The urethral opening, the meatus urinarius, is situated just above the vaginal orifice. In the nullipara it is small and round. In the multipara it is larger and somewhat star-shaped, and there is often some pouting or projection of the urethral mucosa. This change is due to the swelling and distortion during labor, from which the parts never return absolutely to their former condition. The floor of the vestibule is formed of several layers of squamous epithelium and under this the subepithelial connective tissue. There are a few glands, some of which at times become enlarged.

The **hymen** is a circular or crescentic fold of mucosa and submucous connective tissue, situated at the vaginal entrance and partially closing it. The shape of the hymen and the opening in it vary greatly in different persons, some forms being given names. The crescentic hymen and the circular hymen

are the usual forms. The fimbriated hymen has a dentated or fringelike margin. The cribriform hymen presents a number of small holes. In certain cases of malformation, the hymen is absent. In other cases it is closed entirely (imperforate or occluded hymen).

The hymen is usually ruptured at the first sexual intercourse. In some cases "rupture of the hymen" amounts to nothing more than stretching, with slight abrasion. In other cases there is distinct tearing, with considerable pain and some bleeding. In rare cases there may be persistent and even serious bleeding. In some cases the hymen is so rigid or tender as to prevent coitus. Long-continued sexual intercourse stretches the hymen until it is not at all prominent. Much medicolegal importance has been attached to the condition of the hymen, and, ordinarily, it is a decided help in determining whether or not coitus has taken place. But it is a well-established fact that an intact hymen is not absolute proof of virginity, neither is an apparently ruptured or stretched hymen absolute proof of sexual intercourse.
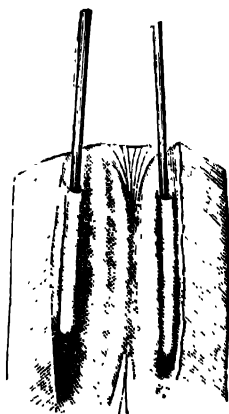
Fig. 120.   Fig. 121.

Fig. 120.—This gives a clear idea of the size and relation of the periurethral ducts (Skene's glands). The floor of the urethra has been divided longitudinally, the end of the urethra raised and a probe introduced into each of the periurethral ducts. (Skene—*Diseases of Women*, D. Appleton-Century Company.)
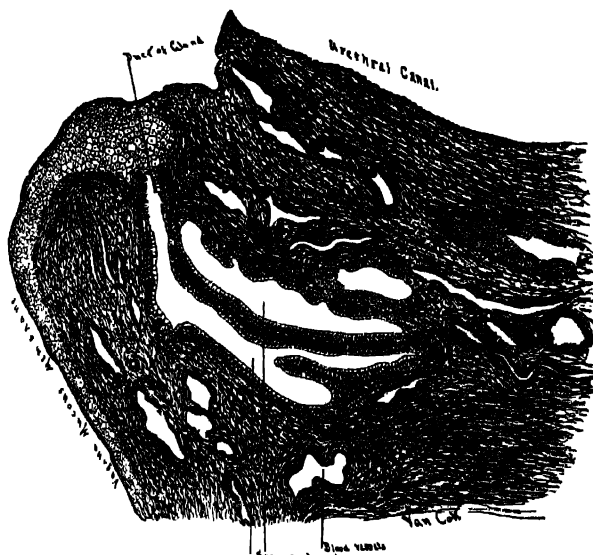
Fig. 121.—A section through the urethra showing the periurethral duct of one side, with ramifications. (Skene—*Diseases of Women*, D. Appleton-Century Company.)

Childbirth destroys the hymen as an intact ring. Usually after parturition there are only irregular tags of tissue left, the result of tearing and sloughing about the vaginal entrance. These irregular tags of tissue surrounding the vaginal orifice are known as "carunculae myrtiformes," and result from childbirth only, not from sexual intercourse. Coitus does not usually destroy the hymen, but simply tears it slightly and stretches it.

The **vulvovaginal glands** are two glands situated beside the vaginal entrance, one on each side at the lower end of the lateral mass of veins called the vestibular bulb, as shown in Fig. 115. They correspond to Cowper's glands in the male, though their relations to the triangular ligament are not so clearly

defined, apparently varying some in different cases. They lie, as a rule, behind the anterior layer of the ligament, and may lie behind or in front of the posterior layer. Each gland lies very close to the lower end of the venous bulb of that side. The gland is a small reddish body about the size of a bean, and belongs to the racemose variety of glands (Figs. 116, 117). Its secretion is discharged through a small duct which opens just in front of the hymen, about the junction of the lower with the middle third of the side of the vaginal orifice. When the gland is normal, this opening has to be looked for rather carefully to be seen. When the gland has once become inflamed, the opening is easily seen, for it is larger and is usually surrounded by a small reddened area. The mucous secretion of the gland acts as a simple lubricant to the parts and is discharged during sexual excitement. When inflamed, the gland is felt as a hard tender mass beside the vaginal opening.

The **meatus urinarius**, as well as the urethra, is lined with stratified squamous epithelium on a basis of connective tissue rich in cells. This connective tissue of the meatus and the urethra presents usually many typical lymph nodules of microscopic size. Just within the meatus, near the posterior wall, are the openings of two diverticula, one on each side. They are known as **Skene's ducts** or Skene's glands. They are called also "periurethral ducts." Their size and shape and location are shown in Figs. 118 to 121. They are important in that gonorrheal infection may extend into them and persist there indefinitely. Just back of the lining of the vestibule there are two masses of veins, one on each side of the vaginal orifice, called the bulbs of the vestibule (Fig. 115). The **bulbi vestibuli** lie just in front of the anterior layer of the triangular ligament. They are supposed to correspond to the corpus spongiosum of the male. In wounds of this region, or in operations, if these vascular bulbs are injured there is troublesome bleeding.

The BLOOD SUPPLY of the external genitals (Fig. 115) comes principally from the internal pudic artery, one of the terminal branches of the anterior trunk of the internal iliac.

The NERVE SUPPLY (Fig. 115) comes principally from branches of the pudic and small sciatic nerves. In certain painful affections of the external genitals, the pudic nerve is sometimes divided or resected to afford relief.

The LYMPHATICS empty into the inguinal glands. Poirier calls attention to the fact that the lymphatics from the clitoris extend into the deep pelvic glands. Consequently in carcinoma of the clitoris proper (not its prepuce), the glands within the pelvis are soon involved.

GYNECOLOGIC EXAMINATION AND DIAGNOSIS

The physician who wishes to do accurate work in the diagnosis and treatment of diseases of women must be in possession of certain facts, as follows:

Knowledge of the anatomy and physiology of the organs involved.

Reliable history and examination of the patient.

Knowledge of the organic and functional disturbances to which the parts are liable and of the differential diagnosis and treatment of them, along with coordinating knowledge which will enable understanding of the situation as a whole as well as of the local disturbance.

Diagnosis is based upon the symptoms given by the patient and the signs found on examination. It should, as far as possible, be both an anatomic and a pathologic diagnosis—that is, it should state the structure involved and the character of the pathologic process. The fact that a diagnosis must eventuate from the history and examination requires that the diagnostic significance of symptoms and signs be kept in mind and utilized as the examination proceeds.

METHOD IN DIAGNOSIS

Accurate and prompt diagnosis is much facilitated by a **grouping of diseases under certain prominent symptoms.** This is the natural method, the one that is followed unconsciously. The prominent sign or symptom in the case brings to mind a group of diseases, and then by the consideration of other ascertained facts, the diagnosis is narrowed down to one or two of these. This differentiation should be made as one proceeds with the examination.

For example, suppose during an examination an ulcer is found on the external genitals. Immediately arises the question, "Is this a chancroidal or syphilitic or tuberculous or malignant or simple ulcer?" Endeavor to settle the question then and there. Recall the facts in the history bearing on the differential diagnosis. Notice the characteristics of the lesion. Is there lymphatic involvement and, if so, of what type? Are there in other parts of the body evidences of syphilis or tuberculosis?

Each important sign must be thus critically considered, and the habit of doing so should be cultivated. In a few cases the diagnosis is apparent from a few prominent facts, but in most cases, particularly in deepseated and serious diseases, the diagnosis must be established by a **critical analysis** of the mass of information obtained in the history and examination. It is this critical analysis, this testing and elimination of diseases that do not stand the test, that makes the difference between the careful diagnosis and the snap diagnosis, between a reliable diagnostician and an unreliable one.

This effective application of the signs to the diagnosis should, as far as practicable, be **made promptly and rapidly,** as they are encountered in the examination. Though in a systematic history and examination all the important

facts are supposed to be obtained, yet if the application of the symptoms to the diagnosis is made as one proceeds, certain points of particular importance in the diagnosis in that case will be given the special attention which they require. Hence the importance of having in mind for immediate use, the diagnostic significance of the common signs encountered.

Consider Extragenital Conditions

Disturbing symptoms in the lower abdomen or back do not necessarily mean genital disease. The trouble may be in some other structure in that vicinity or elsewhere. In this connection we must consider the following structures:

Digestive System—Gastroenteritis, Appendicitis, Cecal Tuberculosis or Tumor, Colitis, Diverticulitis, Proctitis, Hemorrhoids, Tumor of Rectum or Colon.

Urinary System—Urethritis, Cystitis, Bladder Stone or Tumor, Pyelitis, Ureteral Stone or Stricture, Kidney Stone or Tumor.

Skeletal System—Arthritis of Sacroiliac, Sacrococcygeal, Lumbar or Lumbosacral Joints, Vertebral Tuberculosis or Tumor or Injury, Postural Backache or Occupational Strain.

Nervous System—Tabetic Crises, Transverse Myelitis, Neuritis and Neuralgia, Hysteria and Other Forms of Psychic Pain.

It is not necessary to go into detail regarding the above conditions; to name them is sufficient to call attention to them for differential diagnosis. Most of the serious mistakes in diagnosis come not from ignorance of the symptoms of various diseases but from the fact that the missed disease was simply not thought of when deciding on the cause of the patient's symptoms.

Grouping of Pelvic Symptoms

Having concluded from the brief preliminary questioning that the trouble is probably in the genital tract, the next step is to determine to what general group of pelvic disturbances this belongs. It is interesting to note that in nearly all cases of a distinct lesion the symptoms presented fall easily into one of two groups. One of these may be designated as the "inflammatory symptom-complex" and the other as the "new growth" set of symptoms.

INFLAMMATORY SYMPTOM-COMPLEX

SYMPTOMS	LESIONS
Acute onset	Inflammation
Sharp pain	Tubal pregnancy —
Tenderness on examination	Endometriosis
Remissions	Tumor with twisted pedicle or
Recurring attacks	complicating inflammation

NEW GROWTH SYMPTOM-COMPLEX

SYMPTOMS	LESIONS
Gradual onset	Uterine tumor
Pressure or dragging	Ovarian tumor
Not tender	Prolapse or other displacement
Continuous	of the uterus
Gradual increase	Relaxation of pelvic floor

In complicated cases there may, of course, be a combination of conditions with consequent mixture of symptoms, but uncomplicated lesions usually drop readily into one or the other of these two symptomatic classes.

There are, however, gynecologic patients without any lesion. They constitute a third class—the "functional" group. The symptoms may simulate those of either class of lesions or they may be a mixture. The diagnosis of functional disturbance is made by elimination of a definite lesion through satisfactory examination. The "functional group" includes endocrine, vitamin, and nutritional disorders, allergic manifestations, postural or occupational strain or congestion, and neurologic and psychic disturbances. The pelvic symptoms from any one of these disorders may be very real and distressing and require careful discriminating active treatment. This fact should be kept in mind by those physicians who, as a writer has well remarked, "When they cannot discover something with the microscope or the stethoscope or a test tube or the x-rays, in a patient who is obviously ill, have the unspeakable gall to tell the suffering one that 'there is nothing the matter.' "

Pitfalls in Diagnosis

Before taking up the details of gynecologic examination and diagnosis, it is well to call attention to some of the pitfalls which the practitioner will encounter. Forewarning may put him on the alert and diminish the number of bitter surprises which come with experience. If gynecologic diseases always followed a typical course and the patient always picked out from her subjective disturbances the identifying ensemble of symptoms, gynecologic diagnosis would be easy work in which the tyro could proceed confidently and safely, and the experienced gynecologist would have to look elsewhere for the difficult problems and unexpected findings which give spice and interest and development to life. But there is no necessity of going elsewhere for difficult problems or stimulating surprises. Gynecologic diagnosis furnishes plenty and to spare, as every gynecologist can testify. It has been said that "The abdomen is the greatest surprise-box ever opened," and the pelvic portion of it is not the least disconcerting.

The particular diagnostic difficulties pertaining to each disease will be considered in the chapter treating of that disease, but it may be helpful to call attention here to certain difficulties having a general bearing. Keeping these in mind constitutes a part of that diagnostic alertness or eternal vigilance which must be exercised in working safely through the maze of diseases and their combinations and associated conditions.

Errors About a Pelvic Mass.—A common error is to interpret a mass as something which it is not. The nature of a pelvic mass must be determined *indirectly*. We cannot see it or touch it directly, except through the danger of peritoneal invasion. There are no sounds which identify it (except in late pregnancy or aneurysm). Our palpation of it must be through intervening tissues which may obscure its outlines or give a false impression as to its size and consistency. Attempts to overcome these difficulties have aided some, but they have not removed the necessity for trained palpation nor for gray-matter activity on the possible interpretations of what is felt. The "educated

touch" is acquired laboriously through multiplied trial and interpretation and revealing demonstration at operation or autopsy, so it is well to start the process early.

The *apparent size* of a mass under vagino-abdominal palpation depends a good deal on the thickness and consistency and tension of the intervening tissues, particularly the abdominal wall as indicated in Figs. 122 to 124. The *apparent consistency* may be misleading on account of the intervening tissues or on account of failure to palpate completely. The *apparent tenderness* of the uterus or other pelvic mass must be interpreted with caution. For example,
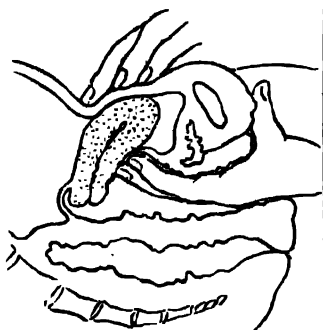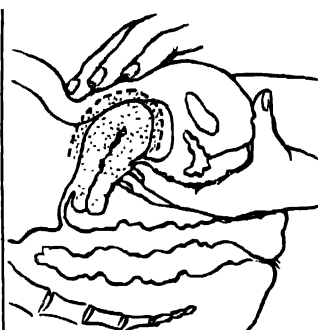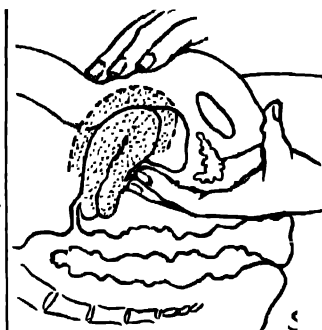
Fig. 122.   Fig. 123.   Fig. 124.

Figs. 122 to 124.—Error in estimating size of uterus may be caused by thick abdominal wall, particularly when wall is very thick, as in Fig. 124.
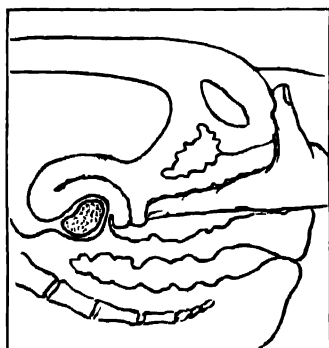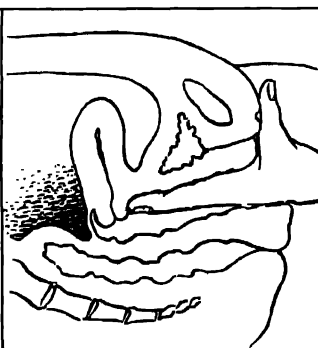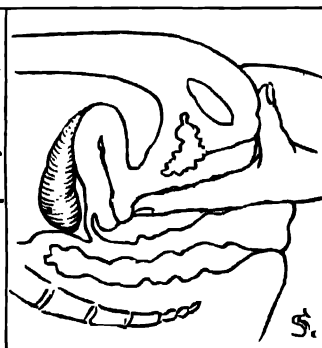
Fig. 125.   Fig. 126.   Fig. 127.

Figs. 125 to 127.—Various cul-de-sac conditions which may cause pain when cervix is pressed on. Fig. 125.—Ovary under retrodisplaced uterus. Fig. 126.—Inflammatory mass. Fig. 127.—Tube, enlarged by inflammation and prolapsed.

when pressure on the cervix causes pain do not jump to the conclusion that the cervix is tender. Consider other conditions which may cause pain when the cervix is moved or pressed on, such as those shown in Figs. 125 to 130. Again, tenderness may be due also to neuritis in the area. Remember also that pain is a subjective symptom which may be a referred psychic phenomenon or possibly a deliberate attempt to deceive.

Errors About the History.—The information obtained from the patient occupies a large place in the diagnosis in most cases, and in some cases certain items are of decisive importance. The history, however, is largely a subjective

matter, the "facts" as stated being the patient's interpretation of recalled sensations which often were, even at the time, not clearly defined in content or origin. In addition, there are the suggestive and other psychic factors to be considered. Occasionally also there is attempt at deception, the patient endeavoring to build up a claim for damages for some alleged accident or pretending acquired disease as a cause for divorce or hoping for abortion from some instrumental examination or treatment.

Errors About Tests.—When by the history and pelvic examination the diagnosis has been narrowed down to two or three conditions, decisive differential diagnostic information may often be furnished by one of the various special tests. An important point to keep in mind, however, is that in many instances the diagnostic significance of the result of a laboratory test depends on the associated clinical findings. The test simply furnishes one item of information, and for use in clinical diagnosis this test-item must be correlated with the items obtained from the history and the examination. Even the test-item itself (the pathologist's interpretation of what he sees) may need to be varied
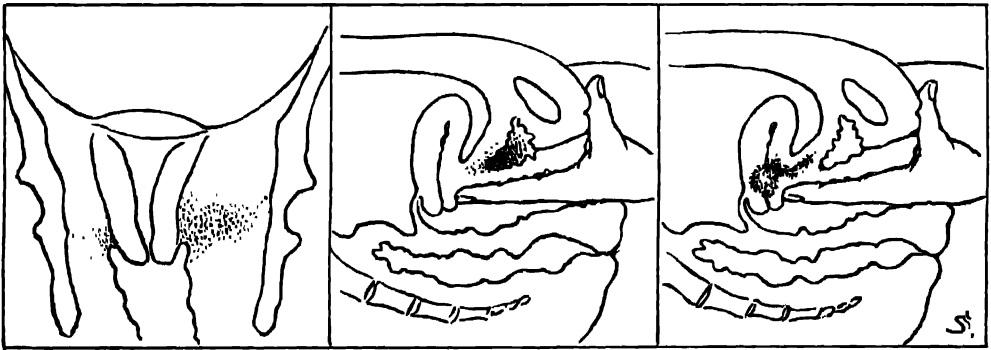
Fig. 128.   Fig. 129.   Fig. 130.

Figs. 128 to 130.—Other conditions causing pain when cervix is pressed on. Fig. 128.—Parametritis. Fig. 129.—Cystitis. Fig. 130.—Uterine inflammation or cancer.

with the clinical findings. Consequently, helpful coordination between the clinician and pathologist is necessary to avoid serious mistakes on each side.

Facts and Assumptions.—Owing to the hiatuses in our knowledge of deepseated conditions in a patient even after a careful examination, some assumptions are usually necessary in making a diagnosis. For example, in palpating a pelvic mass there are some portions the outlines of which can be clearly felt and other portions the outlines of which cannot be felt. To complete the diagnosis we assume a certain approximate outline in the nonpalpable area, endeavoring to avoid error by careful interpretation of all the findings. The outline of the palpable portion represents a fact while the outline of the nonpalpable portion represents an assumption. Unless constantly on guard we are likely to overlook the relative dependability of the two in working toward a conclusion. It is so easy to allow the probable to slip into the positive class, to be used later as a positive factor in deciding between diagnostic possibilities, that this process not infrequently leads to a wide error in diagnosis. The reason for the error becomes apparent as one traces back from the

operation-findings through the ways in which the erroneous diagnosis was reached, but it is better to recognize the pitfall before the fall-in.

Ignoring Unaccounted-for Symptoms.—Unaccounted-for symptoms and examination findings are danger signals one must learn to heed. The symptom or examination sign which will not fit into the otherwise satisfying diagnosis is an irritating nuisance to the careless diagnostician but a stimulating question mark to the careful one. An unaccounted-for symptom indicates that there is something still unknown about the case, and as long as its cause remains unknown it throws doubt on the correctness or completeness of the diagnosis. "A word to the wise is sufficient."

HISTORY

A few preliminary questions as to the principal complaint will put the patient at ease and indicate the general type of disturbance. The systematic record is then begun, and care should be taken to cover the important items under the following headings.

History Record

Social Items—Name, address, age, married, occupation.

Previous Health—General health, abdominal inflammation, nervous disturbances, operation, etc.

Pregnancies—Confinements, miscarriages, sterility.

Menstrual History—Beginning, regularity, duration, amount, pain, last two menstruations.

Beginning of Present Trouble—When, how, cause.

Principal Symptoms—Character, time of onset, duration of each.

Disability—Confinement to bed, interference with work, etc.

Complications—Character, onset, duration.

Family History—In special cases, nervous disturbance, tuberculosis, etc.

Previous Treatment—Different kinds, results.

Summary of chief symptoms demanding relief.

It is well to put down the facts not strictly medical when beginning the written record, for if postponed some of them are liable to be overlooked altogether. Record accurately the patient's name, address, age, whether married or single; and if single, the occupation; if married, how long. If she has been married more than once, or if a widow, or if living apart from her husband, she will probably mention the fact and also any correlated facts bearing on the present disturbance. For business reasons, it is advisable to note other items of information—for example, the husband's occupation and business address.

After completing the history and before beginning the examination, fix in mind the chief symptoms for which the patient seeks relief. Keep these in mind while making the examination and endeavor to find the lesion or condition that causes each of them. These symptoms serve to indicate the directions for special investigation. The diagnosis should be made, to a considerable extent, as the examination progresses. Before finishing the examination, you should have formed an opinion as to whether or not you have found the cause or causes of the symptoms which brought the patient to you.

Keep a Record

A short record, giving in a systematic way the principal facts of a case, may be made quickly and more than repays for the time consumed. And the principal advantage is not the permanent record it gives for reference after some years, though that is important, especially to the teacher, but the fact that it systematizes and steadies and improves the physician's work day by day. Such an account of the case in black and white, referred to frequently as the patient returns for treatment, is a constant stimulus to accurate diagnosis and a constant help in the treatment, particularly if the case is a long-continued one. Again, in court a physician is supposed to have some record of his work. You may at any time be called upon to testify as to the exact findings in the case of some patient whom you saw several years before.

Is a Pelvic Examination Required?

After obtaining the information the patient can give concerning her illness, the next step is to make the physical examination, provided there are symptoms indicating that such examination is needed.

In the case of a **virgin,** pelvic examination is rarely indicated until after medication has been tried and failed to give relief. Occasionally, however, a young woman will present such symptoms that local examination at once is advisable to exclude tumor or other serious lesion. In such case, abdominal examination, inspection of external genitals to exclude inflammation or imperforate hymen, and rectoabdominal palpation will usually give sufficient information to exclude serious pelvic disease.

If conditions still remain doubtful and a small hymen precludes digital palpation, examination under anesthesia may be required. In a bleeding case, curettage may be needed, at once or after trial of medication, and the vaginal examination may be postponed till then, thus sparing the girl an ordeal and also obtaining much more information.

On the other hand, in the case of a **married woman,** if decided pelvic symptoms are present, an examination should, as a rule, be made at once, particularly if there has been previous treatment without satisfactory result.

If the patient is **menstruating,** the examination is of course postponed, unless there is urgency. A nonmenstrual bloody discharge is not a contraindication to examination, but rather an additional indication for it.

If the patient is extremely anxious to avoid the examination, treatment without it may be tried for a while in a suitable case, even though immediate examination seems decidedly preferable. But the physician should be cautious of assuming responsibility for the treatment of alleged conditions which he has not been allowed to investigate.

PHYSICAL EXAMINATION

Physical examination consists of the general and the local examination. The **general examination** should be pursued far enough to give a reliable idea of the general physical condition, to show any serious disturbance, and to indicate whether the patient's disability is probably due to pelvic disease or to some extrapelvic trouble.

In the **local examination** an investigation is made of the genital tract and adjacent structures. The **steps** in the local examination and the **order** of their employment which the authors find most convenient when the patient can be placed on a table are given in the following outline. It is in this order also that the various methods are taken up for detailed consideration.

When the patient is sick in bed at home, the order of examination is more frequently abdominal, vaginal, vaginoabdominal, and rectoabdominal. Inspection of the external genitals and the speculum examination are usually not required in such a case, but of course should be employed if they will furnish needed information.

Regular Steps

In the Local Examination

Abdominal Examination.
Inspection of External Genitals.
Vaginal Examination (Digital).
Vaginoabdominal Examination (Bimanual).
Speculum Examination and taking specimens of Discharge.
Rectoabdominal Palpation.
Localization of Backache.

In the case you are considering, the regular examination and history may furnish all the information needed for diagnosis and treatment, so that after making the examination you are in a position to proceed at once with the therapeutic directions. On the other hand, there may still be questions to be answered to enable satisfactory diagnosis and effective treatment.

Most of the serious mistakes in diagnosis are not due to ignorance but to oversight of the possibilities in the case. Hence it is well to present the possibilities in a suggestive outline which can be taken in at a glance. This outline will serve as a memorandum of the various examination measures which may be helpful in special gynecologic and associated conditions.

Special Examinations

Colposcopic Magnification of Cervix Lesions.
Chemical (Iodine) Test of Cervix Covering.
Determination of pH of Vaginal Contents.
Endometrial Biopsy.
Gas Test for Tube Patency.
X-Ray Examinations.

With opaque material for location of tubal occlusions and outlining tubal and endometrial cavities.

For fetal bone shadows, calcified structures (dermoid, myoma), possible foreign body.

For lesions of intestinal tract (appendicitis, intestinal growth or stenosis) or of the urinary tract (prolapsed kidney, stone, hydronephrosis, ureteral lesions).

For arthritis, metastatic growths, or other lesions of pelvic bones and lower spine.

Of skull for sella turcica deformity in pituitary endocrine disturbances and for internal exostosis in severe menstrual headaches.

Pelvic Palpation under Anesthesia (vaginoabdominal, rectoabdominal).

Aspiration of Fluid.

Intra-Abdominal Inspection (through endoscope, through incision).

Endocrine Investigations.

Pregnancy Tests.

Extragenital Examinations (which may be required in certain gynecologic patients, for differential diagnosis or in preparation for operative treatment).

Cardiovascular (heart sounds, pulse, blood pressure, electrocardiogram).

Urinary tract (cystitis, pyelitis, ureteral stone or stricture).

Intestinal (appendicitis, colitis, diverticulitis, stenosis, growth).

Orthopedic (sacroiliac or spinal arthritis, metastasis, postural strain).

Neurologic (neuritis or neuralgia, tabetic pains, spinal growth or deformity, psychoses).

Blood (leucocytosis, agranulocytosis, leucemia, anemia, N.P.N., clotting time, sedimentation time, sugar index, other cellular and serum conditions).

Nutrition and Vitamins (weight variations, digestion, stamina, vitamin deficiencies).

Endocrine (thyroid, ovarian, pituitary, adrenal).

Allergy (foods, medicines, underwear, powders, other contact substances).

In Fever of undetermined origin or other Obscure Conditions, the various infectious diseases must be considered, including gonorrhea, tuberculosis, syphilis, brucellosis, chancroid, granuloma inguinale, lymphogranuloma, as well as infections with streptococci or staphylococci or anaerobic bacteria.

Various Rarer diseases may produce puzzling pelvic lesions, such as actinomycosis and echinococcus disease. Even inert particles may work into the tissues and give rise to obscure lesions (inclusion granulomas), such as the granulomas from inclusion of lycopodium powder grains on gloves in abdominal operation or on rectal suppositories used for rectal distress.

ABDOMINAL EXAMINATION

Have the patient lie near the edge of the bed or table, in a comfortable position, with the head slightly raised on a pillow and the knees drawn up sufficiently to relax the abdominal muscles.

The abdomen is subjected to:

Inspection—Contour, Color, Eruption, Striae, Scars.

Palpation—Tension, Tenderness, Mass, Fluctuation, Fluid Wave, Fat Wave, Fetal Movement, Uterine Contraction, Friction Rub.

Percussion—Area of Dullness.

Auscultation—Fetal Heart Sounds, Vascular Murmur.

Mensuration—For accurate comparison.

In the **local examination** an investigation is made of the genital tract and adjacent structures. The **steps** in the local examination and the **order** of their employment which the authors find most convenient when the patient can be placed on a table are given in the following outline. It is in this order also that the various methods are taken up for detailed consideration.

When the patient is sick in bed at home, the order of examination is more frequently abdominal, vaginal, vaginoabdominal, and rectoabdominal. Inspection of the external genitals and the speculum examination are usually not required in such a case, but of course should be employed if they will furnish needed information.

Regular Steps

In the Local Examination

Abdominal Examination.
Inspection of External Genitals.
Vaginal Examination (Digital).
Vaginoabdominal Examination (Bimanual).
Speculum Examination and taking specimens of Discharge.
Rectoabdominal Palpation.
Localization of Backache.

In the case you are considering, the regular examination and history may furnish all the information needed for diagnosis and treatment, so that after making the examination you are in a position to proceed at once with the therapeutic directions. On the other hand, there may still be questions to be answered to enable satisfactory diagnosis and effective treatment.

Most of the serious mistakes in diagnosis are not due to ignorance but to oversight of the possibilities in the case. Hence it is well to present the possibilities in a suggestive outline which can be taken in at a glance. This outline will serve as a memorandum of the various examination measures which may be helpful in special gynecologic and associated conditions.

Special Examinations

Colposcopic Magnification of Cervix Lesions.
Chemical (Iodine) Test of Cervix Covering.
Determination of pH of Vaginal Contents.
Endometrial Biopsy.
Gas Test for Tube Patency.
X-Ray Examinations.
With opaque material for location of tubal occlusions and outlining tubal and endometrial cavities.
For fetal bone shadows, calcified structures (dermoid, myoma), possible foreign body.
For lesions of intestinal tract (appendicitis, intestinal growth or stenosis) or of the urinary tract (prolapsed kidney, stone, hydronephrosis, ureteral lesions).
For arthritis, metastatic growths, or other lesions of pelvic bones and lower spine.
Of skull for sella turcica deformity in pituitary endocrine disturbances and for internal exostosis in severe menstrual headaches.

Pelvic Palpation under Anesthesia (vaginoabdominal, rectoabdominal).

Aspiration of Fluid.

Intra-Abdominal Inspection (through endoscope, through incision).

Endocrine Investigations.

Pregnancy Tests.

Extragenital Examinations (which may be required in certain gynecologic patients, for differential diagnosis or in preparation for operative treatment).

Cardiovascular (heart sounds, pulse, blood pressure, electrocardiogram).

Urinary tract (cystitis, pyelitis, ureteral stone or stricture).

Intestinal (appendicitis, colitis, diverticulitis, stenosis, growth).

Orthopedic (sacroiliac or spinal arthritis, metastasis, postural strain).

Neurologic (neuritis or neuralgia, tabetic pains, spinal growth or deformity, psychoses).

Blood (leucocytosis, agranulocytosis, leucemia, anemia, N.P.N., clotting time, sedimentation time, sugar index, other cellular and serum conditions).

Nutrition and Vitamins (weight variations, digestion, stamina, vitamin deficiencies).

Endocrine (thyroid, ovarian, pituitary, adrenal).

Allergy (foods, medicines, underwear, powders, other contact substances).

In Fever of undetermined origin or other Obscure Conditions, the various infectious diseases must be considered, including gonorrhea, tuberculosis, syphilis, brucellosis, chancroid, granuloma inguinale, lymphogranuloma, as well as infections with streptococci or staphylococci or anaerobic bacteria.

Various Rarer diseases may produce puzzling pelvic lesions, such as actinomycosis and echinococcus disease. Even inert particles may work into the tissues and give rise to obscure lesions (inclusion granulomas), such as the granulomas from inclusion of lycopodium powder grains on gloves in abdominal operation or on rectal suppositories used for rectal distress.

ABDOMINAL EXAMINATION

Have the patient lie near the edge of the bed or table, in a comfortable position, with the head slightly raised on a pillow and the knees drawn up sufficiently to relax the abdominal muscles.

The abdomen is subjected to:

Inspection—Contour, Color, Eruption, Striae, Scars.

Palpation—Tension, Tenderness, Mass, Fluctuation, Fluid Wave, Fat Wave, Fetal Movement, Uterine Contraction, Friction Rub.

Percussion—Area of Dullness.

Auscultation—Fetal Heart Sounds, Vascular Murmur.

Mensuration—For accurate comparison.

INSPECTION OF ABDOMEN

Contour

ALSO MOVEMENT, COLOR, ERUPTION, STRIAE, SCARS

The principal thing to determine by inspection is **contour**. Determine also the other items mentioned—movement of wall, color, eruption, striae, scars—but usually they are of secondary importance. As to contour, there may exist one of several conditions, as follows:

> The smooth, moderately full contour of the normal abdomen.
> The flat, sunken abdomen of wasting disease, with empty intestines.
> A swollen, prominent abdomen.

Fig. 131 shows normal contour, as the patient is prepared for abdominal examination. In the enlarged abdomen the contour or simple outline may give some idea of the cause of the enlargement. In Figs. 132 to 135 the contours of moderate ascites, marked ascites, cystic tumor, and solid tumor are shown and contrasted.

PROMINENCE OF THE ABDOMEN

Decided prominence of the abdomen is due to many different affections—so many that it is difficult to remember them in an ordinary list. They are easily remembered, however, when grouped according to location. Thus conveniently arranged, they form five groups, as follows:

> A. Some Affection of the Abdominal Wall.
> B. Something in Intestines.
> C. Something in Peritoneal Cavity.
> D. Some Enlarged Organ.
> E. Tumor from Pelvis or Abdomen.

A. Abdominal Prominence From Some Affection of Wall

Obesity (Fig. 136).—There is evidence of fat deposit in other parts of the body. The abdominal wall may be picked up as a thick roll, and the fingers made almost to meet beneath (Figs. 137, 138, 139), showing that most of the prominence is due to the thickness of the wall. There is no distinct localized mass, like a tumor in the wall.

Percussion gives resonance all over the abdomen. Sometimes a distinct "fat wave" may be obtained, but it may be distinguished from a "fluid wave" by the expedient shown in Fig. 173, and also by percussion. In some cases, when the patient stands, a distinct roll of fat drops below the general abdominal contour, as shown in Fig. 140. Prominence from obesity has been mistaken for ovarian tumor, and also for pregnancy (Fig. 141).

Tumor of Wall.—There is a distinct mass, which is superficial and moves with the wall and is apparently inseparably connected with it. The mass may be picked up and the fingers approximated beneath it. There is no apparent connection with any intra-abdominal organ. There is dullness on light percussion, but resonance on deep percussion. Fig. 142 shows a tumor of the abdominal wall.
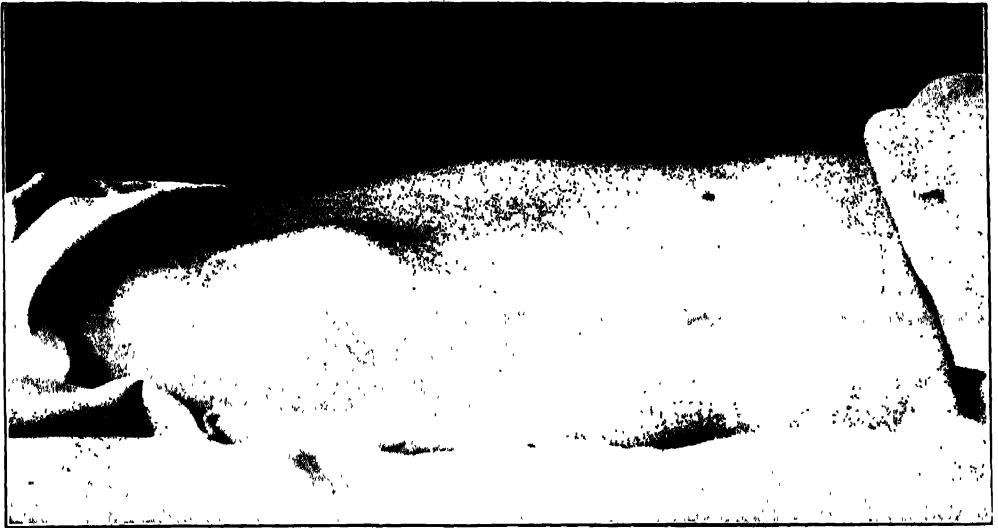
Fig. 131.—Profile of normal abdomen. Patient arranged for abdominal examination.
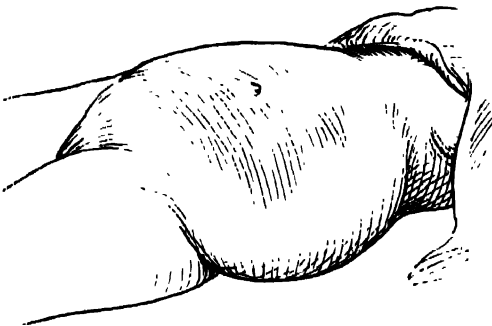
Fig. 132.   Fig. 133.

Fig. 132.—Contour of abdomen in moderate ascites.
Fig 133.—Contour of abdomen in marked ascites.
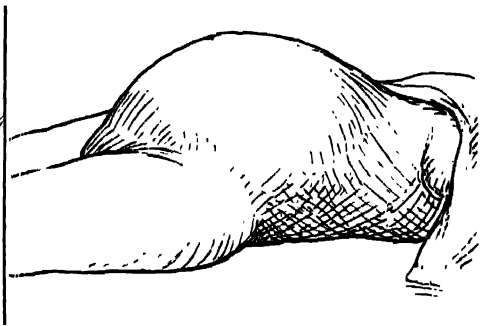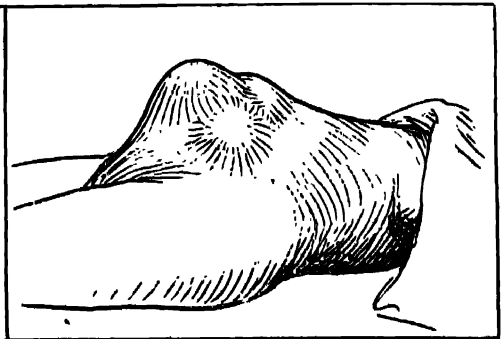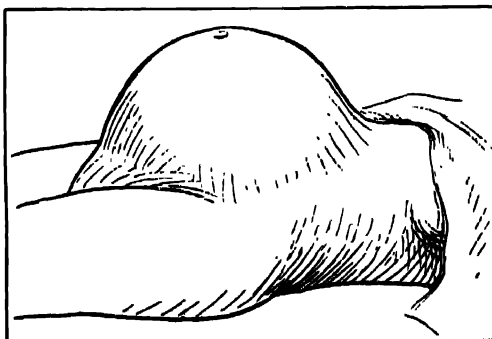
Fig. 134.—Contour of abdomen in cystic tumor.   Fig. 135.—Contour of abdomen in solid tumor.

Inflammatory Mass in Wall.—Same as tumor with evidences of inflammation added—pain, tenderness, fever and, in some cases, redness and fluctuation.

Some years ago the senior author witnessed, as a visitor, an operation upon a supposed strangulated ventral hernia. The patient gave a history of a long-standing swelling some distance to the left of the umbilicus. This suddenly enlarged and became painful, the enlargement being accompanied by abdominal pain, vomiting, constipation, and evidences of inflammation in the mass. The patient was brought before a medical class for operation. As the hernial site was evidently infected, it was decided to open the abdomen elsewhere and deal with the intestine through the clean opening. Accordingly the peritoneal cavity was opened by a median incision. Exploration showed that the peritoneal surface of the abdominal wall on the affected side was perfectly normal. There was no hernia. The trouble was an abscess of the abdominal wall, probably resulting from the suppuration of a tumor. A large operative opening into the peritoneal cavity in such close proximity to an abscess made a very uncomfortable state of affairs for the surgeon, particularly as the abscess was so large and so near the surface that it was thought necessary to open it at once. It was opened as far as possible from the median incision.

Fig. 136.—Obesity. The most prominent feature in this case is the marked obesity.

Ventral Hernia.—There is a distinct localized protrusion, which is most pronounced when standing or sitting, and diminishes when the patient lies down. Coughing makes the mass prominent and gives a distinct impulse to it. The mass is resonant on percussion, when containing intestine, and is partially or wholly reducible. When the mass is reduced, the margin of the opening may be felt. Figs. 143 and 144 show an umbilical hernia. When strangulated and so inflamed as to prevent satisfactory palpation, a ventral hernia may give much trouble in diagnosis, particularly if it contains only omentum.

Relaxation of Wall.—There is general protrusion of the wall when sitting or standing (Fig. 145), which largely disappears when patient lies down (Fig. 146), unless tympanites is pronounced. On palpation the walls are lax and no abnormal mass is felt. The abdomen is everywhere resonant on percussion.

Separation of Recti Muscles.—The recti muscles are ordinarily held firmly together by the junction of the sheath of one side with that of the other side, forming a strong fibrous septum in the median line. In some cases of abdominal distention from pregnancy or a tumor, the tissue between the recti muscles is greatly stretched laterally and remains so. This gives a wide, weak place between the recti muscles in which the tissues are lax and thin (Fig. 147). When the patient raises her head and shoulders from the pillow, or otherwise makes strong intra-abdominal pressure, there is bulging of this weak portion of the wall between the recti (Fig. 148). In such a case, the hand may be sunk deeply into the abdomen between the separated recti muscles (Fig. 149).

Fig. 137.   Fig. 138.

Fig. 137.—Testing the thickness of the abdominal wall. First step.

Fig. 138.—Testing the thickness of the abdominal wall. Second step. The fingers carried beneath the wall.

B. Abdominal Prominence From Something in Intestines

Gas (tympanites).—Gas may cause marked prominence when associated with relaxation of the abdominal wall. There is no distinct mass felt on palpation. Percussion shows hyperresonance over the entire abdomen. There are usually symptoms indicating gastric or intestinal indigestion. Tympanites is frequently associated with enteroptosis. Fig. 150 shows tympanites which the patient mistook for pregnancy.

Fecal Impaction.—Fecal impaction may cause localized prominence in any part of the abdomen, but it is usually situated along the course of the colon. The diagnosis depends largely on the exclusion of other causes of enlargement, the history of constipation, and the effect of treatment directed toward clearing out the intestinal tract. Have the patient take a purgative until free bowel movements are secured, then a large enema and then return for another examination.

C. Abdominal Prominence From Something in the Peritoneal Cavity

General Ascites.—General ascites may be slight (Fig. 151) or marked (Fig. 152). In ascites, i.e., free fluid in the peritoneal cavity, the abdomen is inclined to spread out at the sides and flatten at the top. There is usually a
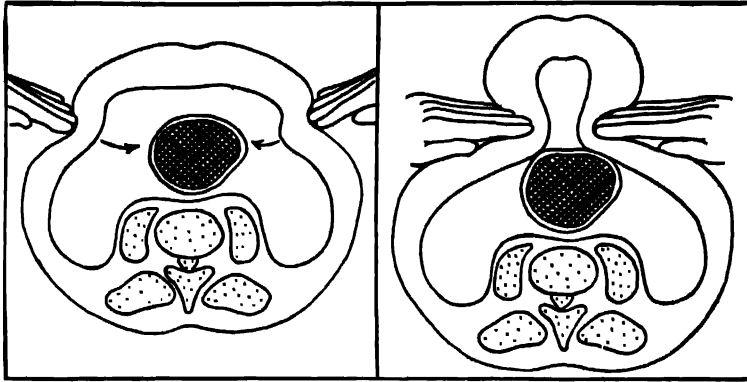
A.   *B.*

Fig. 139.—Testing thickness of abdominal wall. *A,* First step. *B,* Second step. Fingers carried beneath the wall.

Fig. 140.   Fig. 141.

Fig. 140.—Obesity. Patient standing. Same patient as shown in Fig. 136. Notice the thick roll of subcutaneous fat that drops down below the general contour of the abdomen.

Fig. 141.—Obesity, mistaken for pregnancy by patient. (Williams—*Obstetrics.*)

distinct fluid wave, obtained as explained in Fig. 172. When the patient is turned on the side or when she sits or stands, the area of dullness changes, because the fluid seeks the lowest part of the peritoneal cavity (Figs. 175 to 179). Another diagnostic point is that in some cases where there is free fluid

in the peritoneal cavity, when the patient stands there may be decided protrusion of the umbilicus, which protrusion disappears when the patient is in the recumbent posture.
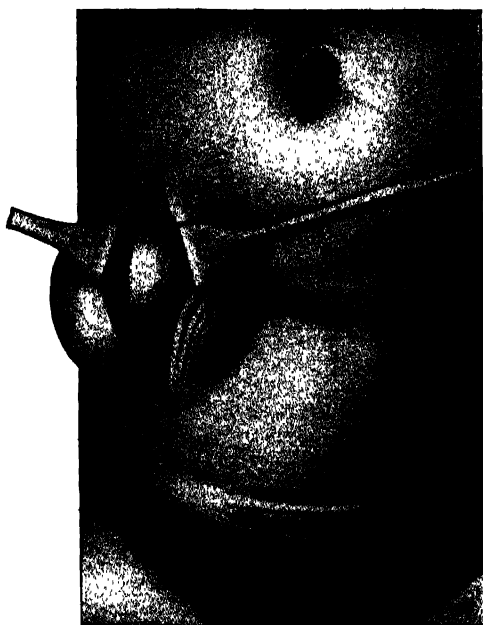
Fig. 142.

Fig. 143.

Fig. 142.—A tumor of the abdominal wall. (Montgomery—*Practical Gynecology*, The Blakiston Company.)
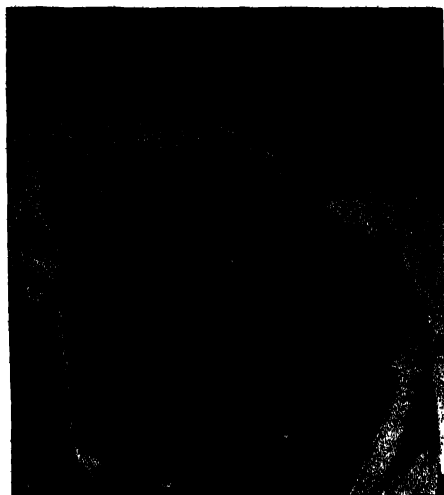
Fig. 143.—A small umbilical hernia, with a relaxed abdominal wall. (Hirst—*Diseases of Women*, W. B. Saunders Company.)

A.

B.

Fig. 144.—Ventral hernia. *A*, Patient recumbent. *B*, Patient standing.

Encysted Fluid (pus or serum or blood).—A distinctly limited collection of fluid, walled off or encysted, may be present in peritoneal tuberculosis and also in abscess from salpingitis or appendicitis. There may be considerable
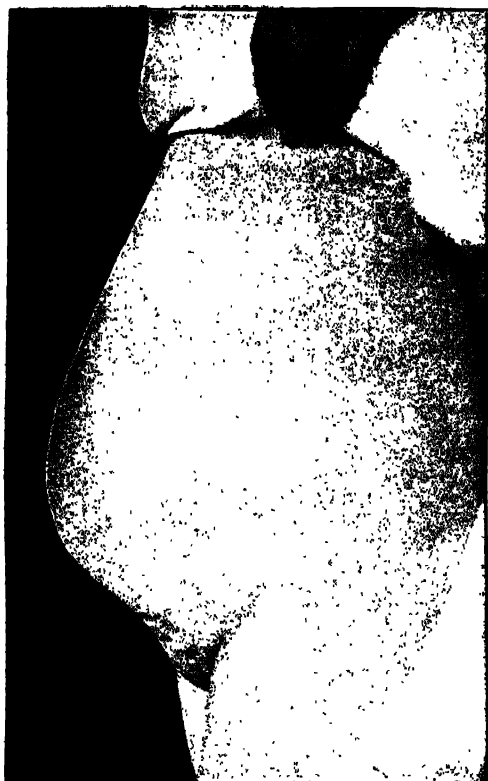
Fig. 145.

Fig. 146.

Figs. 145 and 146.—A patient with relaxed abdominal wall. Contrasting the abdominal prominence when standing with the abdominal contour when lying down.

Fig. 147.
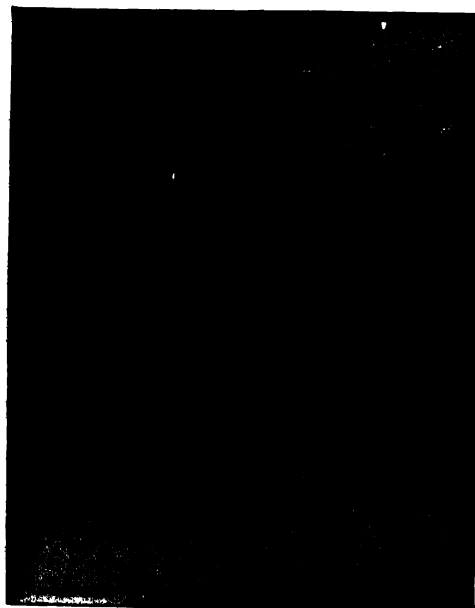
Fig. 148.

Fig. 147.—Median grooving of the abdominal wall where there is separation of the recti muscles. The woman is represented as lying on her back. (Webster—*Diseases of Women*, W. B. Saunders Company.)

Fig. 148.—Patient with marked separation of the recti muscles. The illustration shows the marked bulging between the separated recti as the head and chest are raised from the table, the abdominal muscles being thus made to contract. (Webster—*Diseases of Women*.)
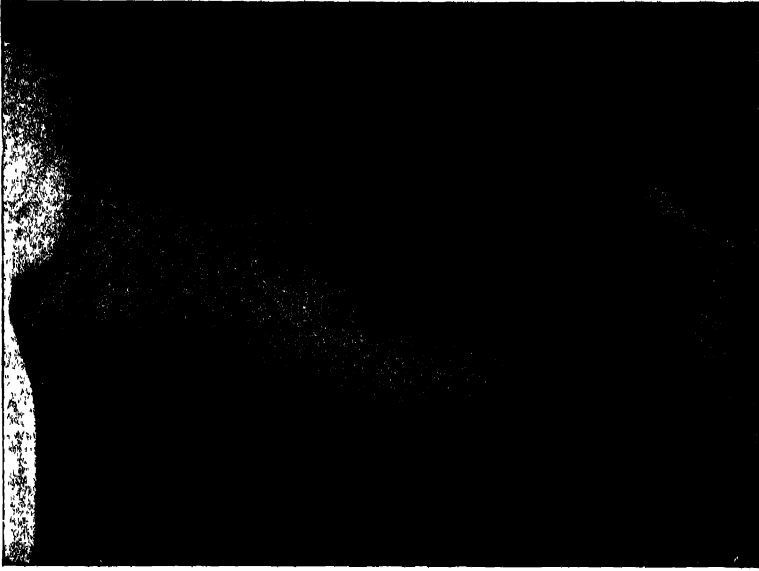
Fig. 149.—Patient with marked separation of the recti. The photograph from which this illustration was made was taken as the upper part of the body was being raised from the table. The physician's fist is buried in the gap between the muscles, which are contracting. In this case there was pronounced pendulous abdomen. As the patient lay relaxed on her back, the distance between the muscles at the level of the umbilicus measured five and one-half inches. (Webster— *Diseases of Women.*)

Fig. 150.—Tympanites, mistaken for pregnancy by the patient. The small figure in the upper corner shows the internal condition as determined by the bimanual examination, the uterus being of normal size. (Edgar—*Practice of Obstetrics,* The Blakiston Company.)

solid exudate associated with the swelling, and also other evidences of inflammation, either septic or tuberculous. The diagnosis between the two forms of inflammation may usually be readily made from the history and the accompanying symptoms. Extrauterine pregnancy, like the inflammatory processes

Fig. 151.—Ascites. A moderate amount of fluid in a relaxed abdomen. Notice how the abdomen spreads out at the sides. (Kelly—*Operative Gynecology*, D Appleton-Century Company.)
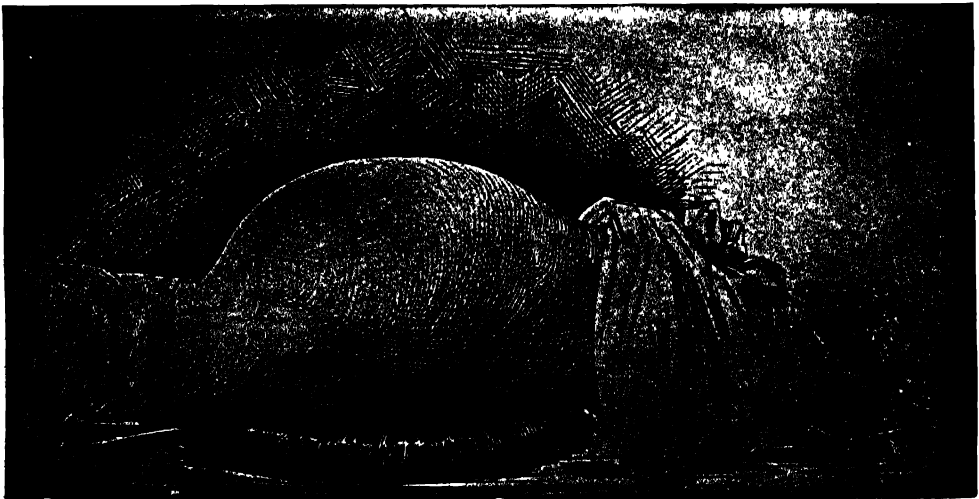
Fig. 152.—Marked ascites. Notice the gentle slope at the lower and upper portions of the abdomen. In the case of a tumor the rise is usually much more abrupt. (Kelly—*Operative Gynecology*.)

just mentioned, may present the evidences of encysted fluid. For the points in differential diagnosis, between extrauterine pregnancy and ordinary pelvic inflammation, see Chapter XI.

Pseudocyst of the Lesser Omentum.—Following injuries or disease of the pancreas, there may be a collection of fluid in the lesser peritoneal cavity,

causing prominence of the abdomen and evidence of encysted fluid. The diagnosis is usually made during the progress of the operation. In all these cases of encysted fluid or solid exudate, there is dullness over that portion of the mass lying against the abdominal wall and resonance elsewhere.

Fig. 153.—Contour of the abdomen in pregnancy, with patient recumbent. (Edgar—*Practice of Obstetrics*, The Blakiston Company.)
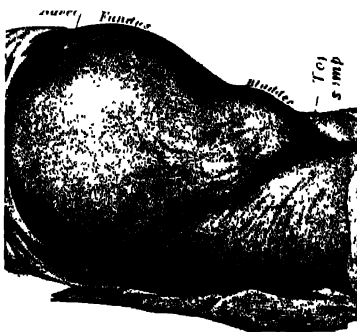
Fig. 154.
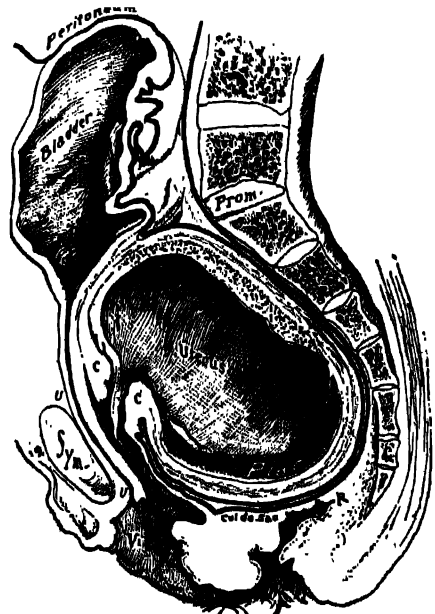
Fig. 155.

Fig. 154.—Contour of the abdomen in a case of distended bladder. The patient is in labor. Notice how well the bladder prominence stands out from the general abdominal prominence due to the pregnant uterus. (Norris—*American Textbook of Obstetrics*.)

Fig. 155.—Frozen section of the body of a woman who died from rupture of a distended bladder. The cause of the retention of urine was a retroverted uterus four months pregnant. (Norris—*American Textbook of Obstetrics*, from *Arch. f. Gynäk.*)
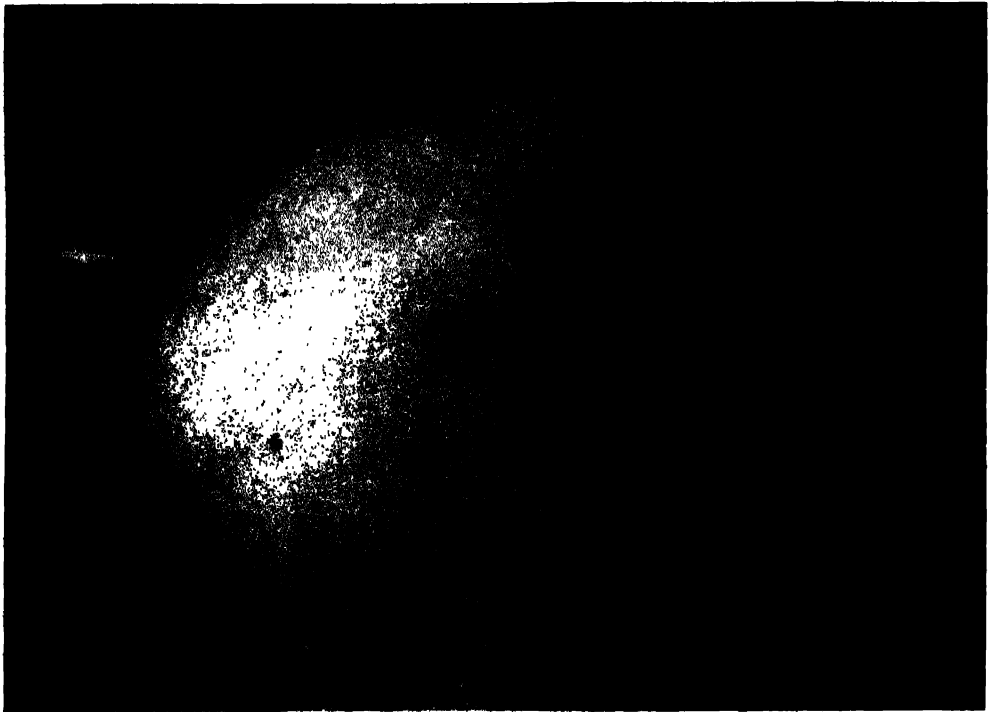
Fig. 156.—Distended bladder, caused by pressure of a tumor.
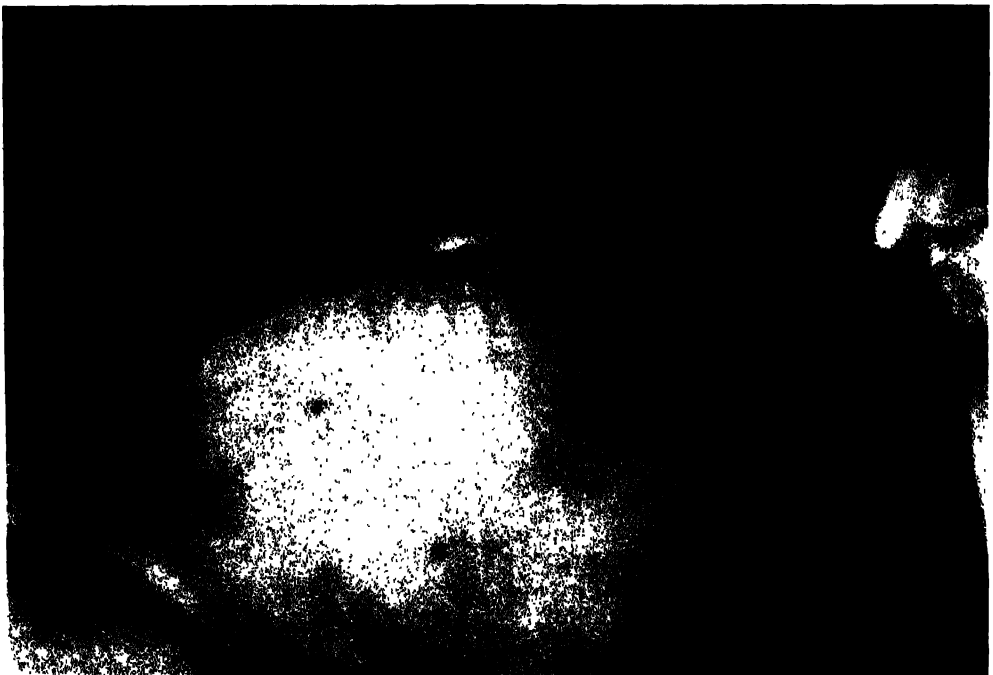
Fig. 157.—Bladder emptied, showing change in contour.

D. Abdominal Prominence From Some Enlarged Organ

Uterus Pregnant (Fig. 153).—There is dullness over the mass and resonance at the sides. There is no change of outline of dullness on change of position of patient. There are also the various signs of pregnancy, including the fetal heart sounds if the pregnancy is far enough advanced.

Fig. 158.—Contour of the abdomen in a case of large cystic tumor (parovarian). Notice the abrupt rise of the abdominal wall at both the lower and upper portions. (Kelly—*Operative Gynecology.*)
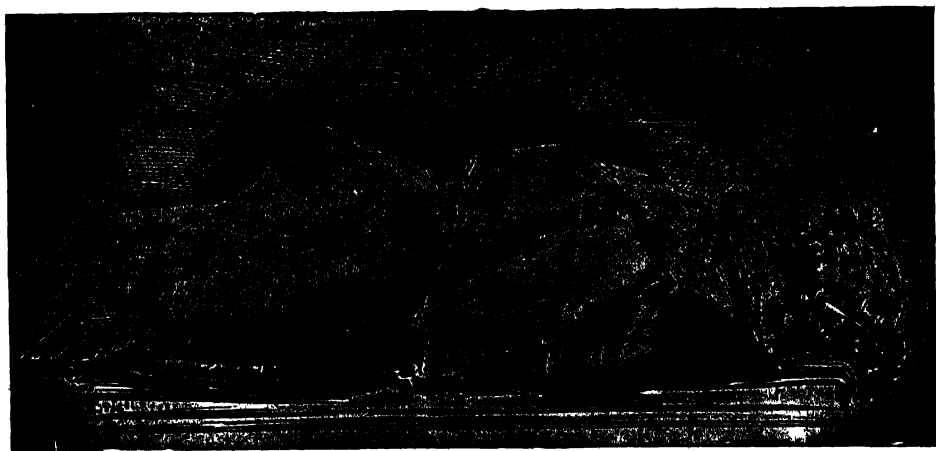
Fig. 159.—Contour of the abdomen in a case of large solid tumor (uterine myoma). The irregularity, so common in solid tumors, is well marked. (Kelly—*Operative Gynecology*, D. Appleton-Century Company.)

Bladder Distended With Urine.—The retention of urine to such an extent that the distended bladder produces a distinct prominence of the abdomen happens occasionally in labor (Fig. 154), in pregnancy with retrodisplacement (Fig. 155), in pelvic tumors compressing the urethra and in certain nervous affections. There is dullness over the mass with resonance at the sides. In one of our cases, examination showed a large cystic mass, presumably an ovarian

cyst with a solid portion deep in the pelvis. In trying to determine the degree of mobility of this deep portion it was pressed on in various directions, and when it was pressed back urine shot out of the urethra. The cystic tumor was distended bladder, holding 2,500 c.c. of urine. Fig. 156 is a photograph of the abdomen with the bladder full and Fig. 157 with it empty.

Spleen Enlarged from chronic malaria, leucemia, or other cause.

Liver Enlarged from malignant disease, hypertrophic cirrhosis, or other cause.

Gall Bladder Enlarged on account of occlusion of duct and distention with mucous secretion and inflammatory exudate. It sometimes becomes so much distended as to form a large cystic mass in the right side of the abdomen.

E. Abdominal Prominence From a Tumor

A Tumor Projecting Up From the Pelvis (Figs. 158, 159).—Such a tumor has its point of attachment in the pelvis, the free margin of the growth extending upward into the abdominal cavity. The growth may be either cystic or solid. There is dullness over the mass and resonance at the sides. There is no decided change of outline of dullness with change of position of patient, except where there is complicating ascites. There are found also the usual symptoms caused by the particular variety of pelvic tumor present.

A Tumor Connected With Some Abdominal Structure.—Such a tumor has its point of attachment in the abdomen with the free margin of the growth extending toward, and sometimes into, the pelvic cavity. There is dullness over that portion of the mass lying against the abdominal wall and resonance elsewhere, unless there be associated ascites. There are symptoms also pointing to the organ affected and to the nature of the growth.

PALPATION OF ABDOMEN

Tension, Tenderness, Mass

ALSO FLUCTUATION, FLUID WAVE, FAT WAVE, FETAL MOVEMENT,
UTERINE CONTRACTION, FRICTION RUB
TENSION AND TENDERNESS

As to **tension,** we determine whether the wall is soft and easily depressed, or is firm and resisting from muscular tension. The latter condition may be due to nervousness or fright, the patient fearing that the examination will cause pain, or it may be due to genuine **tenderness** from inflammation or irritation beneath the wall, as in peritonitis or intraperitoneal hemorrhage.

The best way to begin palpation is to place the palmar surface of the whole **hand flat** on the abdominal wall (Fig. 160, A). Hold it there perfectly quiet for a moment, that the patient may see that you are not going to cause pain. Then, as the muscular tension relaxes, depress the wall carefully with the fingers (Fig. 160, B) in various directions and situations as the hand is moved about over the surface. Begin the movement of the hand gradually, at the same time directing the patient's attention away by a question or two. When the patient's attention is fixed on the palpating hands, there is likely

to be troublesome tension of the wall. As the examination proceeds, **deep** palpation is made in various parts of the abdomen in order to exclude disease in the various regions. Palpation with **both hands** assists much in determining the character and consistency of the tissues between them and under them,

A.   B.

Fig. 160 —*A*, Palpation of the abdomen. First step. Hand flat on abdominal surface. *B*, Palpation. Depressing the wall with the fingers of one hand, in various situations.
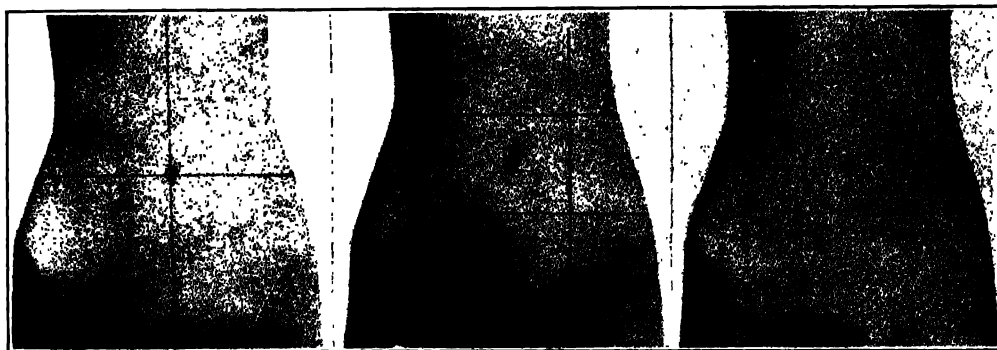
Fig. 161.   Fig. 162.   Fig. 163.

Fig. 161.—The abdominal surface divided into quadrants.

Fig. 162.—The usual anatomic division of the abdomen into nine regions by two transverse lines and two vertical lines. The upper transverse line is at the level of the cartilages of the ninth ribs, and the lower with the highest points of the iliac crests. The two parallel vertical lines pass through the cartilages of the eighth ribs and the middle of Poupart's ligaments.

Fig. 163.—Division of the abdomen into regions by means of a circle with a two-inch radius and two-inch horizontal lines.

particularly when the abdomen is rather full. If a resisting area is found, work the fingers around it, depressing the wall and examining all portions of it. The palpation should always be made **gently,** for if the manipulations cause pain or frighten the patient, the wall is immediately made tense and then no satisfactory-examination is possible.

In a case of suspected appendicitis or one-sided inflammation, the difference in tension of the abdominal wall on the two sides is of diagnostic importance.

Having determined the general tension and tenderness, search is made for **local tenderness.** The exact location of the tenderness should be carefully
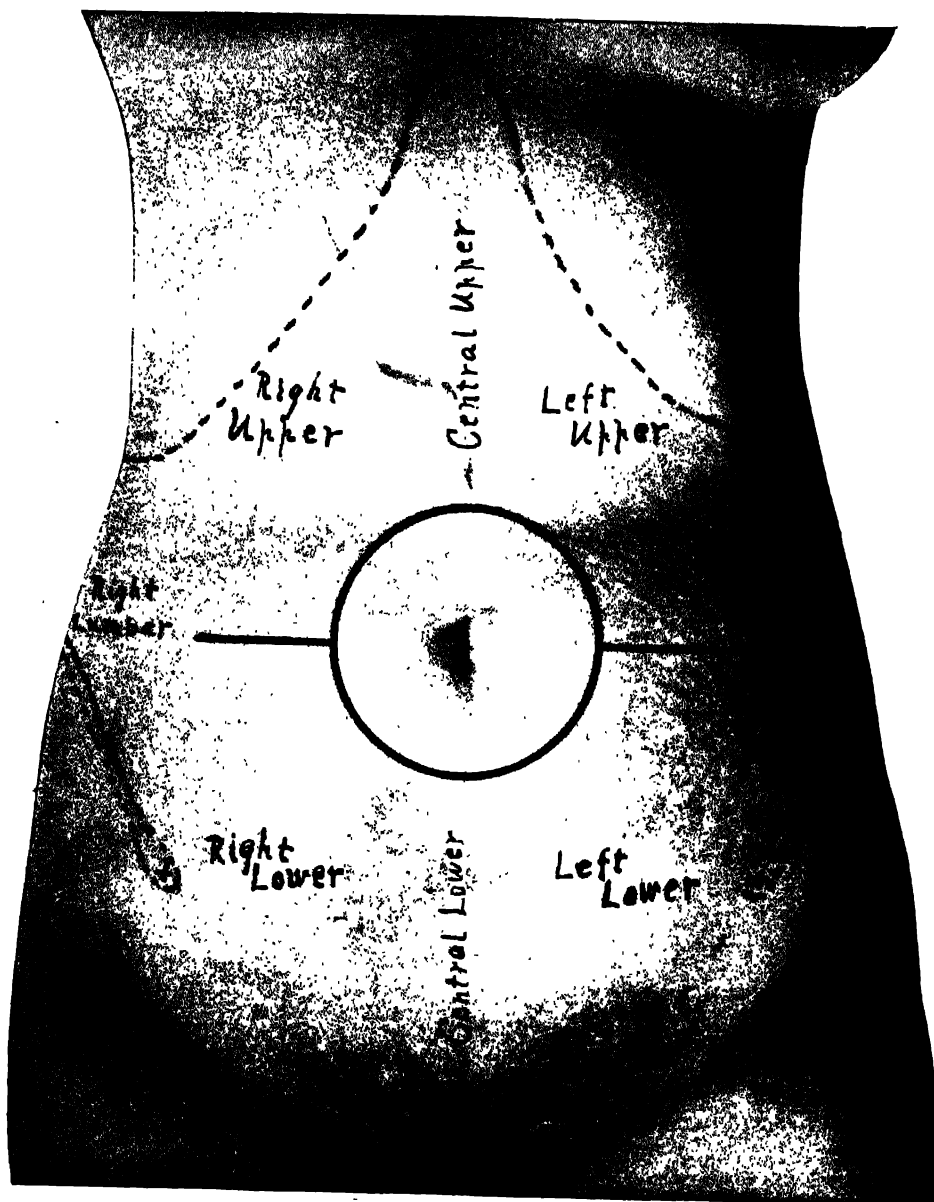
Fig. 164.—Another abdomen divided with the circle and short horizontal lines, and showing the names on the primary regions. The area within the circle carries the usual designation, "umbilical region."

determined, and also whether it is circumscribed to that area or extends to other areas. When the area of tenderness has been accurately located, we know what organs are likely to be affected, and the further differentiation between affections of those organs may be proceeded with.
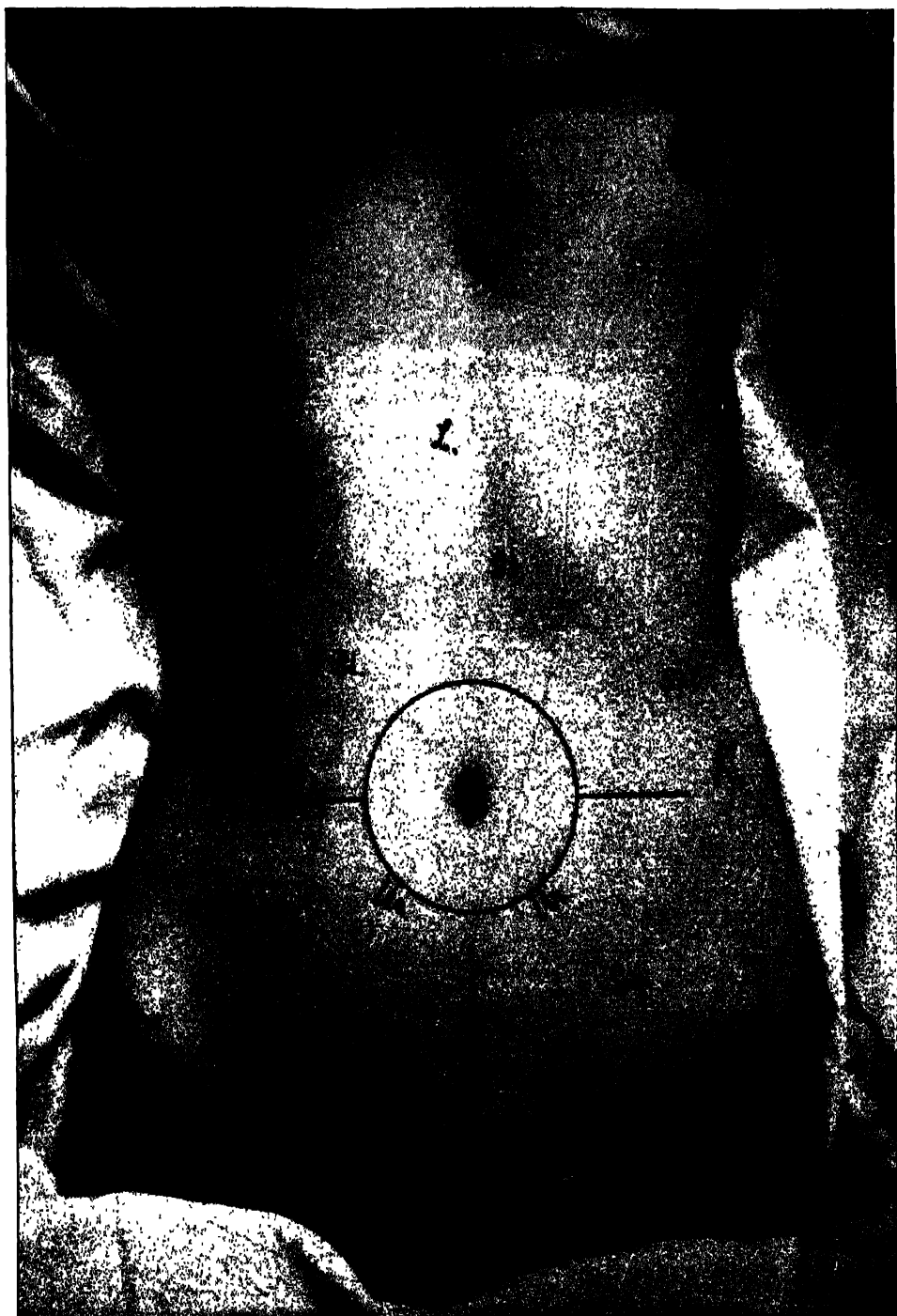
Fig. 165.—Various areas of significant point-tenderness. These are the areas to be investigated during the course of an abdominal examination.

Regions of the Abdomen.—For convenience in designating the location of tenderness or of a mass, the abdomen is divided into regions. There are several methods of division. A simple one is the division of the surface into quadrants by an imaginary horizontal line passing through the umbilicus and a vertical line through the same point (Fig. 161).

This is used in obstetrics for designating the approximate location of the fetal heart sounds and is convenient for designating in a general way the location of large masses, but it is not sufficiently definite for the accurate localization of small masses or points of tenderness.

For the more definite localization, there is the time-honored anatomical division into squares (Fig. 162). As a practical working division for diagnostic and teaching purposes, however, this has been found decidedly unsatisfactory, as is attested by the many attempts of clinicians to devise a simple method of dividing the surface and of designating the various regions.
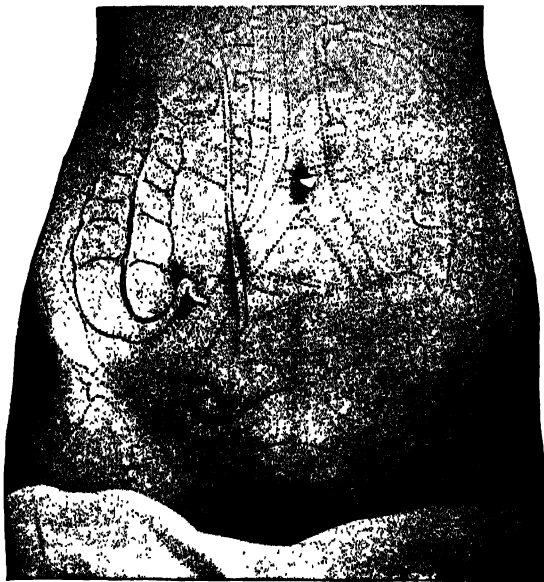
Fig. 166.   Fig. 167.

Fig. 166.—The right lower abdomen. The organs commonly affected and the areas accordingly of particular interest are indicated by the stippling.

Fig. 167.—Palpating the area of the appendix and cecum. Appendix tenderness is usually most marked about the middle of a line from the umbilicus to the anterior superior spine of the ilium, slightly nearer the latter (McBurney's point).

Failing to find a method of division that was satisfactory—clinically, we devised that shown in Fig. 163, which, so far as we know, is original. The only lines not marked by natural landmarks are a circle with a two-inch radius about the umbilicus and a short straight line extending horizontally for two inches from each side of the circle.

The **regions** are designated as right lower, left lower, central lower, right upper, left upper, central upper, umbilical, and right and left lumbar (Fig. 164). This method of division is simple, and the names are easily remembered and are self-explanatory. In fact, these designations are the ones commonly used in conversation among physicians in describing the location of a mass or

area of tenderness. For example, we speak of tenderness in the right lower region of the abdomen, or, more briefly, in the "right lower abdomen," or in the "left lower abdomen," or in the "right upper abdomen," etc.

Within each of these principal regions there are one or more points which are of special interest. The special interest attaches to each one of these points because well-defined tenderness limited to such point usually means an affection of a particular organ. It must be kept in mind, however, that in some cases such point-tenderness is due to an affection of some adjacent organ (as when inflammation within the cecum causes tenderness in the appendix region), or even of some distant organ which has become displaced (as when the right kidney has become displaced into the appendix region).

Again, in some cases tenderness is due to an organic or functional disturbance of the nerves of the abdominal wall or to reflected pain, due to a lesion in some other part of the abdominal cavity or to some organic or functional lesion in a distant part of the body. But even in these exceptional conditions the tenderness is usually not genuine "point-tenderness," but is more extensive and can be traced in some direction sufficiently far to indicate its probable origin.

With the above-mentioned exceptions kept in mind, the special **areas of point-tenderness** are of great help in the differential diagnosis of abdominal lesions. The most significant ones are shown in Fig. 165.

Tenderness in Right Lower Abdomen (Fig. 166)

Tubal or Ovarian or Broad Ligament Disease (inflammation, tumor, extrauterine pregnancy).—The tenderness is most marked low in the side near Poupart's ligament (tuboovarian region). It does not ordinarily extend to the appendix region though it may, in exceptional cases, involve both regions. A mass may be felt on vaginoabdominal palpation between the uterus and the pelvic wall. There is a history of uterine and pelvic inflammation or other pelvic disturbance.

Appendicitis.—Tenderness is most marked about the middle of a line drawn from the right iliac spine to the umbilicus (McBurney's point). By sinking the fingers deeply into the abdomen near the umbilicus and then carrying them outward toward the iliac spine (Fig. 167), the appendix may often be felt to roll under the fingers as a tender cord. There is usually a history of stomach or bowel disturbance and of attacks of pain radiating about the umbilicus and finally settling down in the appendix region.

Some Disease of the Cecum or Ascending Colon.—Inflammation, tumor, and intussusception are the more common affections of the cecum. They present much the same local signs as mild appendicitis. The tenderness and the mass are not localized to the appendix region, however, but extend up along the ascending colon.

Stricture of the Ureter.—There is a painful point over the ureter and tenderness extending up and down its course. There is usually pain extending from the kidney along the ureter, to the bladder. There is nearly always decided tenderness over the kidney, and often tenderness in the broad ligament portion of the ureter.

Fig. 168.

Fig. 169.

Fig. 168.—Palpation of a movable kidney, with the patient on her back. First step. The loin is grasped as here shown, to prevent the displaced kidney from slipping unnoticed back into its place at the beginning of palpation.

Fig. 169.—Palpation of a movable kidney, with the patient on her back. Second step. Palpating the kidney with the right hand while it is held in displacement with the left hand.
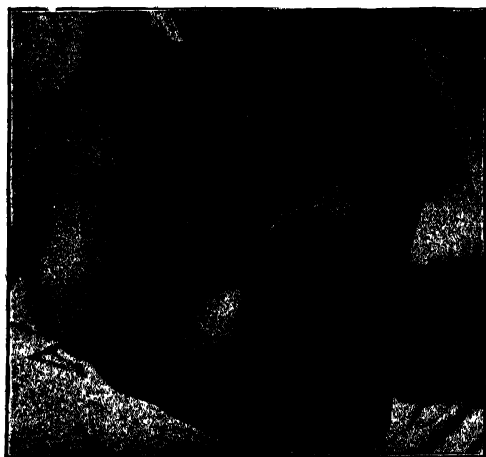
Fig. 170.

Fig. 171.

Fig. 170.—The point for kidney tenderness laterally.

Fig. 171.—The point for kidney tenderness posteriorly.

Movable Kidney.—A rounded mass is felt on deep palpation in or near the appendix region. It is somewhat tender. It is movable and may be displaced upward into the kidney region. Special methods for palpating it are shown in Figs. 168 and 169. There is a history of irritable bladder, particularly when standing or walking. There may be pain radiating from the kidney region along the ureter to the bladder. The urinary findings will indicate whether or not there is inflammation or irritation along the urinary tract.

Kidney Disease, for example, a tumor or tuberculosis or inflammation, may cause tenderness extending from the kidney down into the right lower abdomen. Kidney disease is indicated by tenderness at certain points (Figs. 170, 171) and enlargement, and by the urinary findings.

Intestinal Disease.—Painful diseases of the small intestine, either acute or chronic, may give rise to tenderness in the right lower abdomen.

Tuberculous Peritonitis and other forms of peritoneal disease occasion tenderness here, when extending to this region.

Nervous Affection.—Various organic and functional nervous diseases cause marked hypersensitiveness of the abdominal surface and of the intra-abdominal structures. The pain complained of is out of proportion to any obvious sign of disease. By palpating over the abdomen it is found that there is tenderness everywhere, even up on the chest walls. Pinching up the skin may cause almost as much pain as the pressure on deeper structures. General observation of the patient will show that she is nervous. Special examination will show evidence of neurasthenia, hysteria, or other disease of the nervous system.

Mass in the Abdomen

When a mass is discovered determine so far as possible its position, size, shape, consistency, tenderness, mobility, and attachments.

The **position of a mass** indicates in a general way the organ or group of organs from which it arises. Keep in mind, however, that it may be due to some adjacent organ, or even some distant organ displaced into that region.

The **size and shape of a mass** are determined by ascertaining its length, breadth, thickness, and general contour. The length or height of a tumor projecting up from the pelvis is usually designated as so many fingerbreadths or "fingers" above the symphysis or below or above the umbilicus. The breadth may be given approximately in fingers or inches, stating at the same time whether or not the mass is situated symmetrically on both sides of the median line; or the mass may be referred to as filling the pelvis from side to side or as filling the abdomen. It is sometimes difficult to convey a satisfactory idea of the general contour of a mass by a detailed description, when it may be very quickly conveyed by referring to some familiar object.

Another method of recording the size and shape of a mass is to draw it within a stamped outline of the pelvis and abdomen.

The **consistency of a mass** should be carefully determined. Is it uniformly solid or does it present hard nodules, or does it contain fluid? If the mass contains a collection of fluid of sufficient size, there may be elicited that peculiar sensation known as **fluctuation,** the recognition of which is one of the first lessons in surgical work.

The **tenderness of a mass** as determined by palpation is of much importance in differential diagnosis. In acute inflammation (as in acute salpingitis or peritonitis), or in acute irritation (as in hemorrhage from tubal pregnancy), the tenderness is very marked. On the other hand, in uncomplicated ovarian or uterine tumors, tenderness is slight.

The **mobility** and **attachments of a mass** are determined by attempting to move the mass in different directions. The fingers are worked in deeply about the mass at various points, and it is determined just what part may be easily displaced and what part is fixed. The fixed point of a mass usually indicates its point of origin, i.e., the organ involved, while the free border indicates the direction of growth, and hence is opposite to the point of origin.

Fixation of a mass may be due to inflammation, exudate or old adhesions, or to malignant infiltration, or to its being retroperitoneal or even in the abdominal wall. It is difficult at times to estimate how much of an abdominal

Fig. 172.   Fig. 173.

Fig. 172.—Trying for a fluid wave across the abdomen.
Fig. 173.—Differentiating a fat wave from a fluid wave. The fat wave is stopped by the pressure in the median line.

enlargement is due to fat in the wall. The maneuver shown in Figs. 137 to 139 is very helpful in determining the **thickness of the abdominal wall.** A mass found in the pelvis does not necessarily originate in the pelvis, but may be an organ or growth from elsewhere. Pelvic spleens and pelvic kidneys have given rise to serious diagnostic mistakes. The differential diagnosis of masses in the pelvis will be further considered under vaginal and vaginoabdominal palpation.

Fluid Wave, Fat Wave, Fetal Movement, Uterine Contraction, Friction Rub

If there is a large collection of fluid, as in a case of marked ascites, a **fluid wave,** started by tapping on one side of the abdomen, may be felt by the other hand applied to the other side (Fig. 172). A somewhat similar wave may be caused, also, by a thick layer of subcutaneous fat (fat wave). In such a case,

however, if an assistant presses lightly in the median line with the ulnar edge of the hand (Fig. 173), the **fat wave** will stop at the line of pressure.

A distinct fluid wave may be obtained in any large collection of fluid with a comparatively thin wall. It is present in well-marked ascites, in unilocular cysts, and in multilocular cysts with one or more large cavities. Occasionally the fact that there are different large cavities in the cyst may be surmised by a distinct difference in the fluid wave as obtained through different parts of the cyst. In a cyst with small cavities no fluid wave is obtained, as there is not a large enough single cavity, although fluctuation may be as clear as in a single large cyst. Also, in a cyst with thick gelatinous contents a fluid wave may not be obtained.

In late pregnancy, **fetal movement,** caused by the fetus' changing position or kicking, may not infrequently be felt. In some cases the hardening and softening of the uterus in contractions may be distinct even in the earlier months of pregnancy, and when felt is evidence of the character of the mass under examination.

PERCUSSION OF ABDOMEN

Area of Dullness

Percussion over the abdomen serves to confirm the information obtained by palpation, and also brings out some new facts—for example, by outlining accurately the **area of dullness** it shows at what portion of the abdominal wall the tumor or fluid lies against the wall, and at what portion there is intervening intestine. It shows also whether the mass or fluid changes relations when the patient changes position. In a ventral hernia (intestinal) it shows that the large mass, which might be taken for a tumor or inflammatory mass, is resonant —i.e., it contains air, and, therefore, must under ordinary circumstances, contain intestine. Endeavor to get definitely in mind exactly the reason for the dullness or resonance found in a particular case, and then its diagnostic significance will be clear.

The use of **superficial** and **deep** percussion in succession may give valuable information in some cases. Ordinary percussion is moderately light and superficial, and gives resonance over all the normal abdomen, except where the liver lies against the wall. In marked obesity, however, superficial percussion is likely to give only dullness over all the abdomen, while deep percussion (a hard percussion stroke against the finger pressed in deeply) gives resonance.

A tumor of the wall or of the omentum ordinarily gives dullness in light percussion and resonance in deep percussion.

An area of dullness where there should be resonance may be due to an enlarged organ, such as distended bladder, or pregnant uterus, or to free fluid (ascites, Figs. 175, 177, 179) or to encysted fluid or to a tumor from some pelvic organ (Figs. 174, 176, 178) or to a tumor from some abdominal organ or to a retroperitoneal growth. The stationary character of the outline of dullness in a tumor on changing position of patient and the shifting dullness in ascites are indicated and contrasted in Figs. 176 to 179.

Fig. 174.
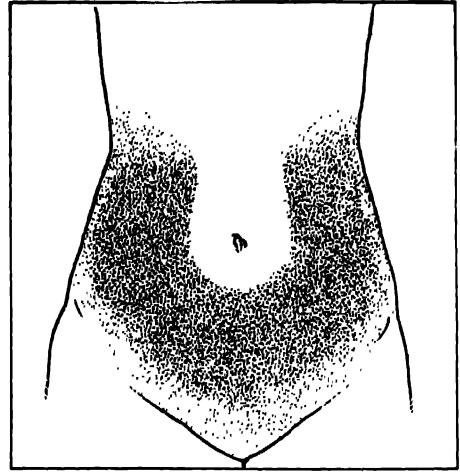
Fig. 175.

Fig. 174.—Indicating area of dullness from a large mass of regular outline rising out of the pelvis, for example, the pregnant uterus or a symmetrical myoma. Dotted line indicates the palpable part of the mass above the dull area. The dull area is the part against the wall.

Fig. 175.—Indicating area of dullness in marked ascites with patient recumbent. (Figs. 174 to 179 are from Butler's *Diagnostics of Internal Medicine*, D. Appleton-Century Company.)

Fig. 176.
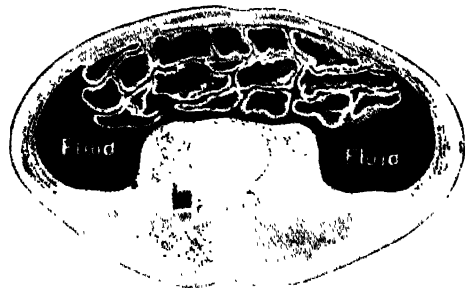
Fig. 177.

Fig. 176.—Indicating the relation of the dull and resonant areas in the case of a tumor occupying the central lower abdomen.

Fig. 177.—Showing the reason for the disposition of the dull and resonant areas in a case of moderate ascites.

Fig. 178.

Fig. 179.

Fig. 178.—Tumor with patient turned on side. No change in area of dullness. Compare with Fig. 179.

Fig. 179.—Ascites with patient turned on side. The fluid gravitates to the under side, leaving the upper flank resonant.

AUSCULTATION

Fetal Heart Sounds, Vascular Murmur

Auscultation assists in differentiating between advanced **pregnancy** and a large ovarian tumor or large myoma. The placental murmur may be simulated by the large vessels of a tumor. The absence of fetal heart sounds does not exclude pregnancy, for even in normal pregnancy they are sometimes difficult to hear. Auscultation should be employed also in obscure cases of pain in the abdomen, for the pain may be due to **aneurysm** of the abdominal aorta or other large vessel, which would give a murmur, and which occasionally runs its course unrecognized until rupture and sudden death. The senior author recalls such a case, the diagnosis being made at the autopsy.

MENSURATION OF ABDOMEN

Measure the abdomen when it is very large or when there is a growing tumor, or when for other reason it may be desirable to know **exactly any difference** in size some weeks or months hence, or when it is desired to speak with accuracy concerning the size of the abdomen in the case of a large growth.

The measurements are made with the ordinary tapeline. When measuring a patient, take enough measurements to make an accurate record. Measurements along the following lines will show variations with a large growth in any part of the peritoneal cavity:

1. From umbilicus to sternal notch.
2. From umbilicus to pubes.
3. From umbilicus to right anterior superior iliac spine.
4. From umbilicus to left anterior superior iliac spine.
5. Circumference of body at level of umbilicus.
6. Circumference of body 3 inches above umbilicus.
7. Circumference of body 3 inches below umbilicus.

EXAMINATION OF EXTERNAL GENITALS AND ADJACENT STRUCTURES

If the patient complains of irritation about the external genitals, or of itching or burning, or of frequent or painful urination, or of sores or swelling or discharge, the parts should be inspected in a good light. For this examination, the patient is draped and the hips brought near the end of the table in a comfortable position, as shown in Fig. 180. A general inspection is then given to see if there is any marked abnormality. The labia are then separated, to expose the vestibule and urethral and vaginal openings, and also the openings of the ducts of the vulvovaginal glands.

By examination determine whether any of the following conditions are present:

Discharge—Mucoepithelial, Mucopurulent, Purulent, Bloody, Watery.
Inflammation—Gonorrheal or otherwise.
Ulcer—Simple, Chancroidal, Syphilitic, Tuberculous, Malignant.

Swelling—Inflammatory, Stasis Infiltration, Edema, Hematoma, Hernia, Cyst.

New Growth—Condyloma, Urethral Caruncle, Lipoma, Fibroma, Malignant Growth.

Malformation—Imperforate Hymen, Adhesions of Labia, Pseudohermaphroditism.

Determine also the:

Condition of Hymen—Intact, Lacerated, Destroyed.

Condition of Perineum—Normal, Lacerated (wide opening, vaginal walls visible, shallow perineum, scar tissue, fistula).

Fig. 180.—Patient in position for examination of external genitals and adjacent structures.

DISCHARGE ABOUT EXTERNAL GENITALS

Mucoepithelial, Mucopurulent, Purulent, Bloody, Watery

Leucorrhea is a term frequently used to designate discharge from the genital tract. Its derivative meaning, "white flow," applies especially to mucoepithelial discharge but through custom it has come to be used as a general term to designate all vaginal discharges except the bloody.

Mucoepithelial Discharge (normal).—The normal mucous secretion from the cervix moistens and macerates the vaginal epithelium. The mixture of this cervical mucus and vaginal epithelium appears at the external genitals as a clear or slightly whitish discharge. Usually it is hardly noticeable, only just

enough to keep the parts normally moist. At the menstrual periods, and under other conditions favoring pelvic congestion, it may increase so as to be somewhat annoying to the patient, though hardly of pathologic importance.

Mucopurulent Discharge.—When there is inflammation or persistent congestion in the uterus, the mucous secretion is much increased, and there are thrown out, at the same time and for the same cause, many leucocytes, which mix with the mucus, giving it somewhat of a purulent character, the prominence of the purulent feature depending on the amount of this admixture of dead leucocytes. If it contains enough mucus to be noticeable, the discharge is sticky and stringy, and may be drawn out into long threads.

Purulent discharge presents the appearance of pus, either thin pus or thick yellow pus, as from an abscess or inflamed surface. Determine just where this comes from—i.e., whether from the urethra or vulvovaginal gland, or inflamed surfaces on the external genitals, or from the vagina.
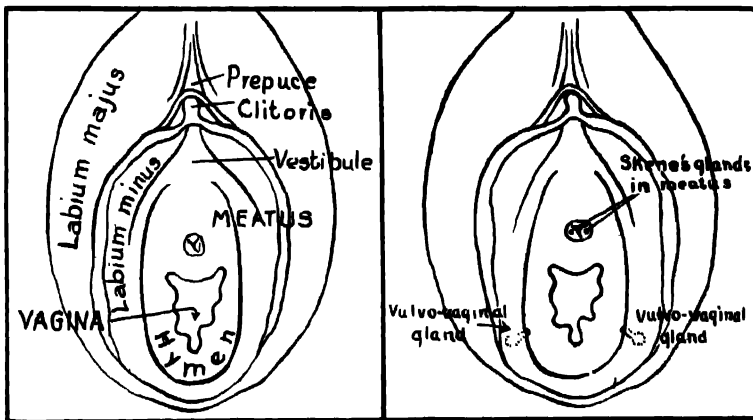
Fig. 181.   Fig. 182.

Fig. 181.—External genitals.
Fig. 182.—Areas most likely to harbor persistent inflammation.

Bloody Discharge.—The discharge is red or brown, the intensity of the color depending, of course, upon the amount of blood. It varies all the way from a slight reddish or brownish tinge, hardly noticeable, to practically pure blood or clots. The blood may be mixed with any of the other pathologic discharges—mucopurulent, purulent, or watery.

Watery Discharge.—This may be due to leakage of urine through a vesicovaginal or ureterovaginal fistula or to rupture of the membranes in pregnancy. Occasionally in a malignant tumor of the vagina or uterus, or when there is a sloughing myoma, the foul discharge will become thin and watery.

Dip the tip of a cotton-wrapped applicator in this purulent discharge and spread some on a microscopic slide.

If possible, secure some discharge from the urethra or vulvovaginal gland (Figs. 181, 182), for the pus from these situations is much more satisfactory for microscopic examination for gonococci than the mixed vulvar or vaginal discharge.

To secure urethral pus, separate the labia, cleanse the meatus, and compress the internal end of the **urethra** by pressure against the anterior vaginal wall with the tip of the index finger. Then, still maintaining the pressure, draw the tip of the finger along the urethra toward the meatus (Fig. 183). This brings the urethral pus to the meatus.

Chronic inflammation in the urethra is likely to be situated in **Skene's glands,** and in such a case some pus may be pressed from these small glands by compressing the urethra (by pressure through anterior vaginal wall) just back of the meatus. In some cases, particularly in a multipara, the urethral mucosa pouts out, so that by careful examination the orifice of one or both of Skene's glands may be seen. Fig. 184 shows such a gland opening (left side) and also a drop of pus which has been pressed from the gland on the right side.

Fig. 183.   Fig. 184.   Fig. 185.

Fig. 183.—Method of pressing pus from the depth of the urethra to the meatus.

Fig. 184.—Slight eversion of urethral mucosa, so that openings of Skene's glands come into view. On left side the gland opening is seen. On right side a drop of pus has been squeezed from the gland and partially obscures the field. (Kelly—*Operative Gynecology.*)

Fig. 185.—Palpating the left vulvovaginal gland, to determine if there is thickening or tenderness, or if pus can be pressed from it.

The **vulvovaginal glands** (Bartholin's glands) are situated symmetrically on both sides of the vaginal opening. The opening of the duct of the gland of each side is situated laterally, just in front of the remnants of the hymen and a little below the middle of the lateral margin of the vaginal opening. Draw aside the labia in this situation and look for the opening of the gland, and determine whether or not the opening is reddened and if there is any discharge from it.

To examine either vulvovaginal gland, to determine if there is any thickening or tenderness from inflammation, or if pus can be squeezed from it, grasp the region of the gland between the index finger in the vagina and the thumb outside, as shown in Fig. 185. When normal, the gland is scarcely noticeable by palpation.

When inflamed, there is thickening and the gland is felt as a small, firm, tender nodule. If pus can be pressed out, make a smear for staining for gonococci. In case of abscess or cyst, the swelling is much larger. A well-marked red area involving the opening of the gland duct indicates previous inflammation, usually gonorrheal, and gives a clew to the origin of inflammatory lesions found higher (cervical, tubal).

VAGINAL EXAMINATION (DIGITAL)

In the vaginal examination, or digital examination as it is frequently designated, one or two fingers are introduced into the vagina and the structures within reach are palpated. In this way valuable information may be obtained in certain cases. It is also a preliminary step to the important vaginoabdominal or bimanual examination, to be taken up later.

Fig. 186.—Position of the fingers for the vaginal and vaginoabdominal examinations.

Method of Examination

Use **two fingers** for the vaginal palpation where the size of the vaginal opening will permit. A much deeper and more accurate examination can be made with both the index and middle fingers than with the index finger alone. Ordinarily in the examination of a married woman, even one who has had no children, two fingers may be introduced without difficulty, provided the fingers are well lubricated and care is taken to cause no pain.

It is important also to separate the labia with the fingers of the other hand while the examining fingers are being introduced, for, if the hair and labia are allowed to roll in with the examining fingers discomfort is caused and the opening is considerably narrowed.

It is advisable to use **rubber gloves** in practically all cases. When intact, they give complete protection against syphilis or other infection which might come through an unnoticed abrasion about the fingers. Another advantage is that less scrubbing of the hands is needed after the examination. Fig. 186 shows the **position of the fingers** ordinarily preferable in the vaginal examination, and the hand gloved and ready for the examination. In introducing the fingers, remember that a bony arch surrounds the vaginal opening above and at the sides (Fig. 187) and that additional space can be secured only by depressing the muscular floor as shown in Fig. 188.
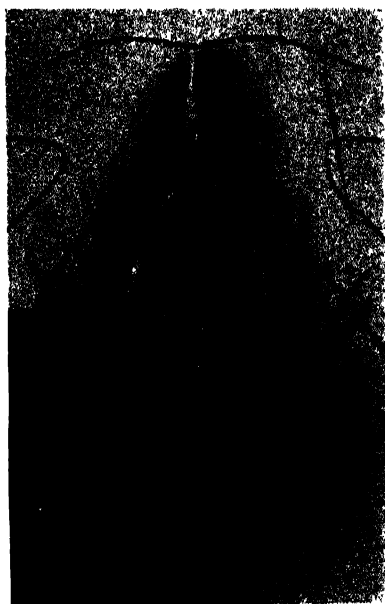
Fig. 187.   Fig. 188.

Fig. 187.—The bony arch, which bounds the vaginal opening above. Additional space needed for examination is secured by depressing the perineum, as shown in Fig. 188.

What Structures to Palpate

With one or two fingers, well lubricated and introduced into the vagina, palpate the following structures:

> **Vaginal Walls**—Roughness, Tenderness, Discharge, Induration, Swelling, Stricture.
> **Base of Bladder**—Tenderness, Induration.
> **Cervix Uteri** {
>   Position,
>   Direction of axis,
>   Size and shape,
>   Laceration and eversion of lips,
>   Condition of external os,
>   Consistency of cervix,
>   Tenderness,
>   Mobility.

Pericervical Tissues—Tenderness, Induration.

Pelvic Floor {
Size of opening,
Resistance to backward pressure,
Protrusion of vaginal walls,
Scars and distortions,
Thickness of perineum.

CERVIX UTERI

Position, Direction of Axis, Size, Shape, Laceration With Eversion of Lips. Condition of External Os, Consistency of Cervix, Tenderness, Mobility

The cervix uteri is felt at the upper end of the vagina as a firm, conical body, projecting through the upper portion of the anterior wall. It is distinguished from the surrounding vaginal wall by its greater hardness.

Fig. 189.   Fig. 190

Fig. 189.— Digital examination to determine position of cervix. Normal position.
Fig. 190 —Digital examination. Cervix low.

Position of Cervix.—The normal position of the cervix is from three to three and one-half inches from the vaginal orifice. The fingers are carried toward the top of the vagina until the tip of the finger touches the cervix. If the vaginal orifice comes well up to the upper end or the third joint of the finger, the cervix is in normal position (Fig. 189). If the cervix is encountered by the finger before it is introduced that far, the cervix is low (Fig. 190). If not encountered at that point, it is high. Another method of determining the position of the cervix is to ascertain whether it is above or below the level of the ischial spines, for normally the lower margin of the cervix lies approximately at the interspinal line.

In cases where, after examination in the dorsal posture, it is still uncertain as to whether or not there is serious descent of the uterus, the patient may be examined in the standing posture. The patient stands, with one foot slightly elevated on the round of a chair or on a small stool, while the examiner, sitting on a chair in front of her, makes the vaginal examination.

Direction of Cervix.—Determine whether the cervical canal, i.e., **the axis** of the cervix, points **across** the vagina above toward the coccyx as it should (Fig. 191), or **along** the canal as shown in Fig. 192. Direction of the cervix forward along the vaginal canal is usually due to backward displacement of the uterus. However, it is sometimes due simply to anteflexion of the cervix.
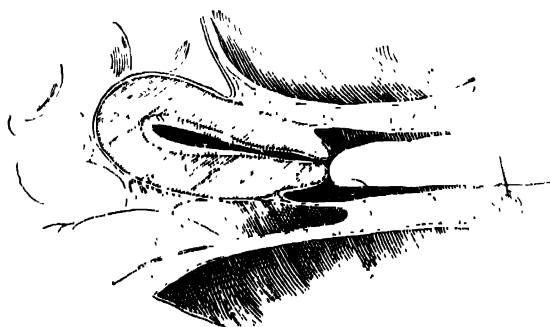
Fig. 191   Fig 192

Figs. 191 and 192—The relation of the cervix to the examining finger   Fig 192, Retroversion of the uterus, showing the relation of the cervix to the examining finger Compare this with Fig. 191, which shows the relation of the cervix to the examining finger when the uterus is in normal position. (Keating and Coe—*Clinical Gynecology*, J B Lippincott Company.)

Fig. 193.   Fig. 194.

Fig. 193 —Palpating the cervix to determine softening The light stippled area represents the softened portion. The uterus is represented as enlarged from early pregnancy.

Fig. 194 —Beginning carcinoma within the cervix, causing a hard nodule, which can be felt on digital examination. (Kelly—*Operative Gynecology*, D. Appleton-Century Co.)

Size and Shape, Laceration and Eversion, Condition of External Os.—The size and shape of the cervix vary much in different individuals, and in the same individual at different periods of life. In women who have never been pregnant the normal cervix has the shape of a rounded cone about one inch wide, and projects into the vagina from one-half to three-quarters of an inch. The external os is small and round, and is at the flattened apex of the cone.

In certain abnormal cases the cervix is very long (an inch to an inch and a half) and pointed. This condition is known as conical cervix. It is frequently accompanied by a very small external os ("pinhole os"), and is one cause of sterility.

In women who have borne children the cervix is larger and broader, and comparatively shorter. The os is a transverse slit and is irregular in shape, and may be large enough to admit the finger tip. There are usually small scars and irregular depressions from lacerations in labor. When the cervix has been severely lacerated, there may be two or three distinct lips. Again, it may, on account of chronic inflammation, become enlarged to two or three times its normal size and may be felt as an irregular ball at the top of the vagina.

Consistency.—The normal cervix is like hard connective tissue, almost as hard as tendon. Its consistency is closely approached by that of the end of the nose when firmly pressed upon. During pregnancy the cervix **softens,** the softening beginning at the lower end and gradually involving more and more as pregnancy advances (Fig. 193). The softening is so marked that the softened portion is sometimes missed entirely.

Abnormal **hardening** of a portion of the cervix may be due to scar tissue, to cystic disease, to a myoma nodule, or to malignant infiltration (Fig. 194).

Tenderness of Cervix.—The cervix is much less sensitive than the vaginal wall, and rarely becomes very sensitive even when diseased. The pain complained of when the cervix is pressed upon is usually due to the pulling upon inflamed periuterine structures, by the resulting movement of the uterus.

Mobility of Cervix.—Normally the cervix is freely and painlessly movable a short distance in all directions. Its range of mobility may be diminished by scar tissue or by malignant infiltration in the upper part of the vagina, or by an inflammatory exudate in the pelvis, or by a uterine tumor, or by any pelvic tumor that fixes the uterus. Its range of mobility may be increased by laceration or overstretching of the supports, posteriorly or anteriorly or laterally, a frequent accompaniment of pelvic floor injuries.

PERICERVICAL TISSUES

Tenderness, Induration

The tissues about the cervix, immediately beneath the vaginal wall, may be palpated, and tenderness or induration noted. If induration is present, note whether it is a distinct, well-defined mass or diffuse infiltration and thickening of the tissues.

PELVIC FLOOR

Size of Vaginal Opening, Resistance to Backward Pressure on Pelvic Floor, Protrusion of Vaginal Walls, Scars or Distortions, Thickness of Perineal Body

Is there loss of support at the pelvic outlet? Is there so much relaxation, due to imperfect healing of an **open tear** or of a **subcutaneous tear,** or due to **subinvolution** of the pelvic sling, that the pelvic organs are not satisfactorily supported? Keep in mind that the important supporting structure in the

Fig. 195.

Fig. 196.

Fig. 195.—Testing the pelvic floor. The vaginal fingers are separated widely, as explained in Fig. 196, and pressed downward

Fig. 196.—Showing the relative position of the fingers when in the vagina, while testing the pelvic floor.

Fig. 197.

Fig. 198.

Fig. 197.—Testing the pelvic floor, especially the left sulcus.

Fig. 198.—Testing the pelvic floor by two fingers introduced into the vagina and then separated.

pelvic floor is the musculofibrous sling formed by the levator ani muscles and fibrous sheaths. The perineal body is of secondary importance, hence a relaxed vaginal opening does not necessarily mean relaxation of the supporting floor, though it usually accompanies such relaxation. Methods of testing the pelvic floor are shown in Figs. 195 to 198.

When there has been **laceration of the sphincter ani muscle,** the torn ends are drawn apart, their location being indicated by a small dimpled scar at each side of the anus. The appearance in relaxation of the pelvic floor and also in laceration of the sphincter ani muscle is shown in the illustrations in the chapter dealing with that subject (Chapter V).

VAGINOABDOMINAL EXAMINATION (BIMANUAL)

The vaginoabdominal examination is, as its name implies, an examination from the vagina and the abdomen at the same time. The pelvic structures are caught between the fingers in the vagina and the fingers over the abdomen, and carefully examined by indirect touch (Figs. 199, 200). By it the body of
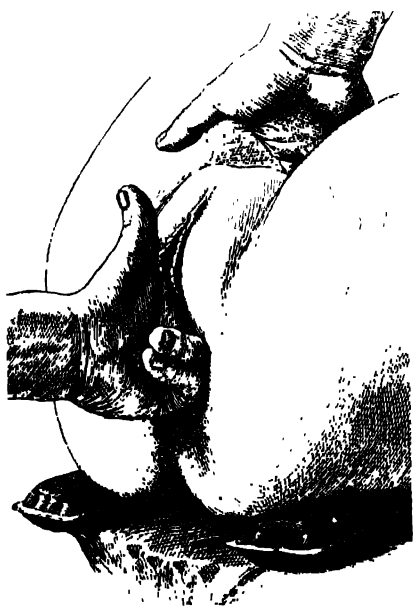
Fig. 199.   Fig. 200.

Fig. 199.—Bimanual examination, showing also the disposition of outside fingers and left thumb. (Kelly—*Operative Gynecology.*)

Fig. 200.—Showing the other disposition of third and fourth fingers along the gluteal crease. This allows deeper penetration of the examining fingers in certain exceptional cases, particularly in very stout patients. (Kelly—*Operative Gynecology.*)

the uterus is located and outlined. The region to each side of the uterus is palpated and also the space back of the uterus. It is determined whether there is any abnormal mass in the pelvis or whether there is any area of marked tenderness.

. To the beginner in gynecologic work this important bimanual examination is often unsatisfactory. He has heard a great deal about tubal and ovarian disease, and he expects to feel the tube and ovary at once. He examines a

patient, or several patients, and can feel neither tube nor ovary if they are normal. Then he is discouraged, and thinks that he has learned nothing from the examinations. And probably he has not learned much, for the simple reason that he was feeling for something that he could not feel, and did not know the significance of what he did feel. Close attention to the details of the examination will prevent this unprofitable experience.

The information concerning the Bimanual Examination may be divided as follows:

> **Palpation of Uterus**—Position, Size, Shape, Consistency, Tenderness, Mobility, Attachments.
>
> **Palpation of Lateral Regions of Pelvis**—Tubes and Ovaries, Mass, Induration, Tenderness.
>
> **Palpation of Other Regions**—Mass, Induration, Tenderness.
>
> **Trained Touch**

PALPATION OF BODY OF UTERUS

Position, Size, Shape, Consistency, Tenderness, Mobility, Attachments

LOCATING THE CORPUS UTERI

Steps.—The locating of the corpus uteri will be much facilitated by proceeding as follows:

1. With two fingers in the vagina, locate the cervix and then push the cervix backward and upward. This tends to tip the fundus forward, as indicated by the dotted line in Fig. 201.
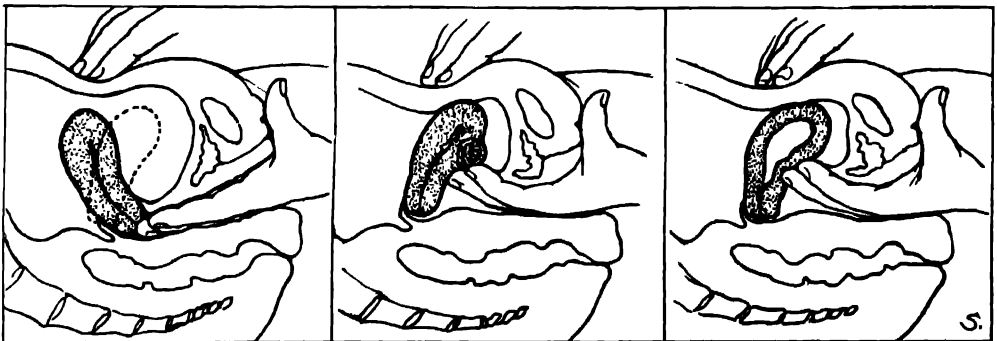
Fig. 201.　　　　　　　Fig. 202.　　　　　　　Fig. 203.

Fig. 201.—Pushing the cervix back and upward, so as to tip the corpus uteri forward within reach of the abdominal fingers.

Fig. 202.—Palpating a nodule on the anterior surface of the corpus uteri.

Fig. 203.—Palpating softening or fluid in the corpus uteri.

2. Then, with the fingers of the abdominal hand depressing the abdominal wall into the depth of the pelvis back of the uterus, bring the fundus uteri well forward.

3. Then, with the pressure still maintained in the direction indicated, slip the vaginal fingers in front of the cervix. The body of the uterus is thus caught firmly between the fingers below and above, and may be clearly felt and outlined (Figs. 202, 203).

Fig. 203.1.—First maneuver in outlining the corpus uteri. Pushing the cervix back and upward, thus tipping the fundus forward so that the abdominal fingers can get back of it. (Netter—Sharp & Dohme Seminar, February, 1943.)

Fig. 203B.— Second maneuver. Slipping the vaginal fingers up the front of the corpus, to palpate its anterior surface as in Figs. 202 and 203 while the corpus is held forward by the abdominal fingers. (Netter—Sharp & Dohme Seminar.)

Three Common Errors.—The following errors are made so often that the authors think it advisable to call particular attention to them.

Error 1. Examining With Partly Filled Bladder (Fig. 204).—If the body of the uterus is not felt in front and still the abdominal fingers cannot be brought well together, have the patient empty the bladder and then examine again. A partly filled bladder is not felt as a distinct mass, and yet there may be half a pint or more of urine——enough to make the palpation very unsatis-
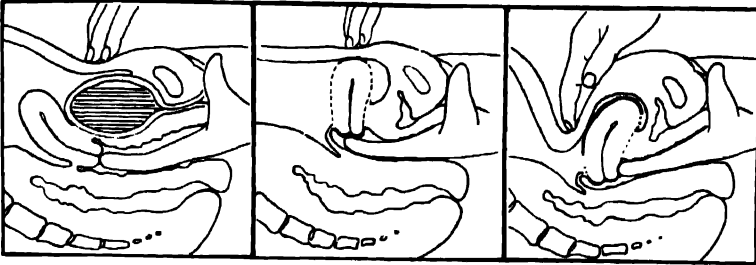
Fig. 204   Fig. 205.   Fig. 206.

Fig. 204.—Bimanual examination. Interfering with deep palpation

Fig. 205.—Bimanual examination. Difficult case in which the uterus cannot be accurately outlined.

Fig. 206. Bimanual examination. Uterus forward, and easily outlined.
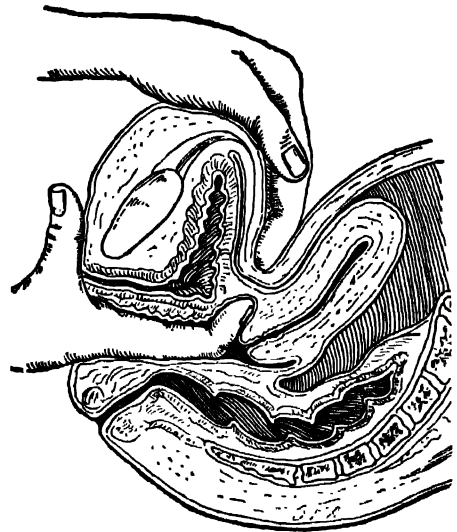
Fig. 207.   Fig. 208.

Fig. 207.—Depression of abdominal wall too close to the pubes. Outside view.

Fig. 208.—Depression of the abdominal wall too close to pubes. Sectional view. (Ashton—*Practice of Gynecology*, W. B. Saunders Company.)

factory. The peculiar thing about this condition is that there is nothing to indicate it, except the difficulty in locating the body of the uterus in deep palpation. No mass is felt and the tissues are all soft and yielding, and there is no particular pain. The fingers seem to sink into the pelvic tissues well, but for some unaccountable reason the uterus is difficult to feel. It seems too far back in the pelvis and yet when you try to bring the fingers together in

front of it, they do not come together well. When such a condition is encountered in an apparently normal abdomen (no marked obesity or muscular tension), it is probably due to a collection of urine in the bladder or to intestinal coils in the pelvis. If it does not disappear after the bladder is evacuated, then elevate the patient's hips, to get the tympanitic intestinal coils out of the pelvis.

To **avoid this error** have the patient empty the bladder shortly before the gynecologic examination. If she cannot urinate she may be catheterized if conditions are found sufficiently doubtful to warrant it.

Error 2. Frequent Shifting of the Position of the Abdominal Fingers.— Some students gouge about in the lower abdomen in various directions in an effort to feel the fundus uteri with the abdominal fingers. This is likely to

Fig. 209.   Fig. 210.

Fig. 209.—Showing the third step in the palpation of the uterus. (Montgomery—*Practical Gynecology*, The Blakiston Company.)
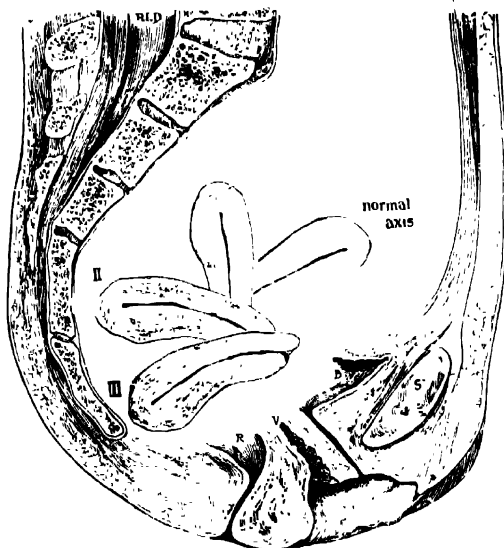
Fig. 210.—Retrodisplacement of the uterus, showing the first, second, and third degrees. (Skene—*Diseases of Women*, D. Appleton-Century Company.)

make the examination a failure in a normal case and it is almost certain to do so in a difficult case. Remember that tension of the abdominal wall interferes with the examination and may defeat it entirely. Remember also that the tension is increased by frequent movements of the abdominal fingers, such as placing them in one position after another in rapid succession, and particularly by endeavoring to gouge in forcibly in various parts of the pelvis in an endeavor to overcome the resistance of the wall. Keep in mind that most of the effective palpation is done with the vaginal fingers, the principal function of the abdominal fingers being to bring the body of the uterus within reach of the vaginal fingers and then hold it there while palpation is being carried out. Get clearly in mind just exactly what movements are necessary to palpate the uterus best.

In order to **avoid this error** just mentioned, place the abdominal fingers so that the depression of the wall will be into the back part of the pelvis, and then carry the fingers by steady and continuous pressure toward the desired region. When you have advanced the fingers as far as possible, hold them there steadily and direct the patient to take a deep breath and then to let the breath all out. As expiration takes place, the fingers may be carried deeper into the pelvis—not by any sudden forcing movement, but by strong steady pressure that does not excite muscular contraction and resistance. If still the fingers are not deep enough in the pelvis, the same movements may be repeated several times. Because the uterus is not felt at once, do not cease the pressure there and begin to depress the wall at some other place. Start the fingers in the right direction at first and then keep them going in that direction steadily, firmly, persistently, without relaxing the pressure, until the depth of the pelvis is reached.
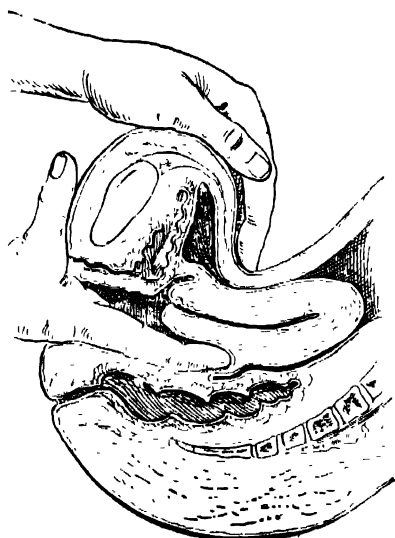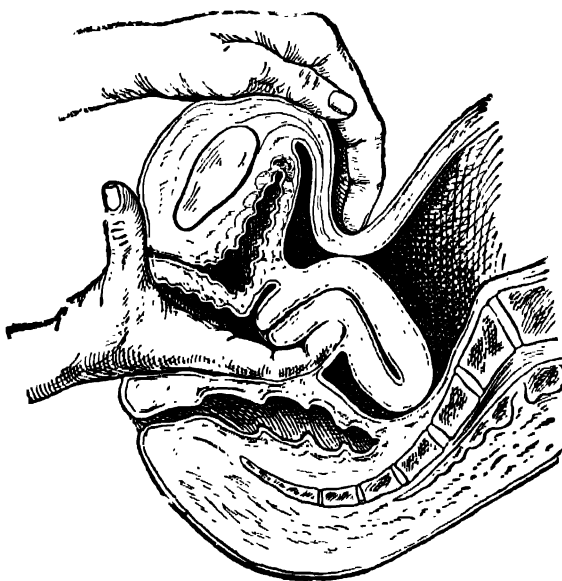
Fig. 211.   Fig. 212.

Fig. 211.—Search is then made in the posterior part of the pelvis, and the uterus is found in retroversion. (Ashton—*Practice of Gynecology*, W. B. Saunders Company.)

Fig. 212.—Indicating the examination findings when the uterus is in retroflexion. Notice the marked angle which is palpable posteriorly at the junction of the cervix and corpus uteri. (Ashton—*Practice of Gynecology*, W. B. Saunders Company.)

Error 3. Depression of the Abdominal Wall Too Close to the Pubes (Figs. 205 to 208).—If the uterus happens to be far forward, this causes no trouble, but if the uterus is very high, as it frequently is from other normal or abnormal cause, the depression of the wall close to the pubes tends to push the uterus backward (Fig. 208). Consequently it is not felt between the examining fingers, though there is no real displacement or was none before the examination was begun.

To **avoid this error,** depress the abdominal wall near the promontory of the sacrum, about midway between the pubes and the umbilicus. In particularly difficult cases it is well to start very high and bring the fingers down upon the sacral promontory, and then allow them to slip over the promontory

into the posterior part of the pelvis. They are then brought forward until the body of the uterus is felt or until the vaginal and abdominal fingers are so closely approximated that the absence of the uterus from that part of the pelvis is demonstrated.

Facts to Determine

When the body of the uterus has been located, then fix in mind the following facts concerning it:

1. **Position** of the Corpus Uteri. Is it in anterior position, as it should be (Fig. 209) or is it displaced backward or to one side?
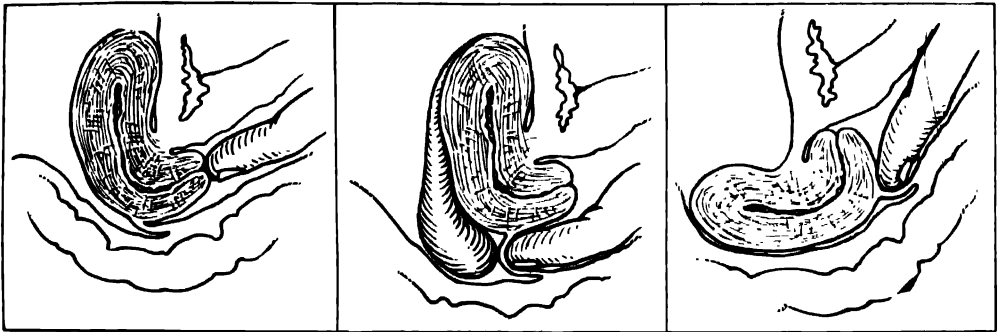
Fig. 213.   Fig. 214   Fig. 215

Fig. 213.—Digital examination, anteflexion of cervix
Fig. 214.—Digital examination, enlarged tube in cul-de-sac
Fig. 215.—Digital examination, retroversion of uterus, with anteflexion of cervix.
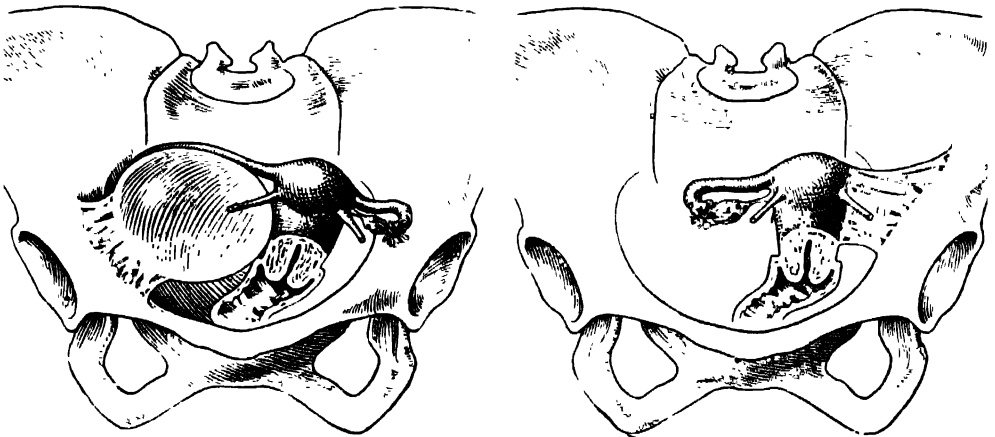
Fig. 216.   Fig. 217

Fig. 216.—Uterus pushed to the left side by a tumor or inflammatory mass in the opposite side. (Findley—*Diagnosis of Diseases of Women.*)

Fig. 217.—Uterus drawn to the left side by adhesions or infiltration in the same side. (Findley—*Diagnosis of Diseases of Women.*)

If it can be determined that the corpus uteri is in the posterior part of the pelvis, the diagnosis is "retrodisplacement," and it is well to note also whether first, second, or third degree, as in Fig. 210. Avoid the terms "retroversion" and "retroflexion," unless it is possible to examine deeply enough to outline the uterus sufficiently for differentiation of types, as in Figs. 211 and 212. The most common type is a combination of version and flexion, as in Fig. 210. Pure

retroversion or pure retroflexion is rare. Occasionally a uterus with anteflexed cervix becomes retroverted, producing a "retrodisplacement of uterus with anteflexion of cervix," as shown in Figs. 213 to 215. The condition back of

B.
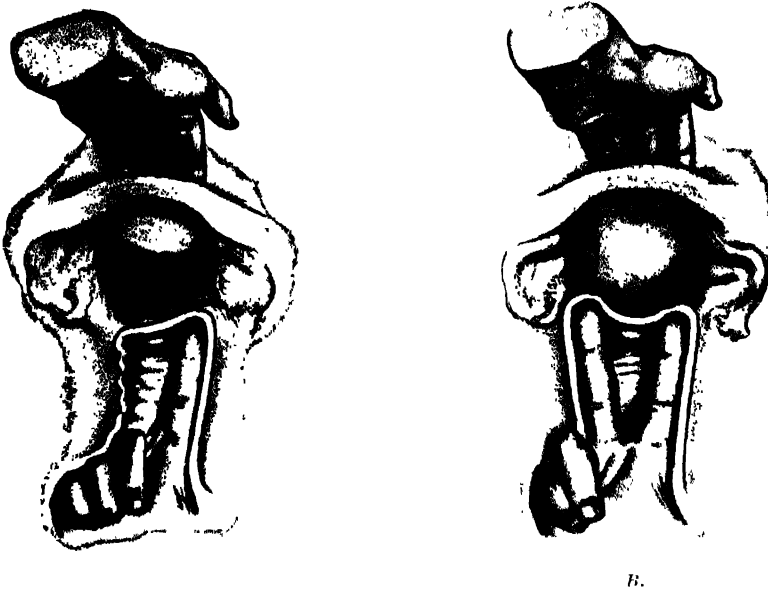
Fig. 218.—*A,* Palpating the margin of the uterus to determine enlargement or irregularity. *B,* Estimating the width of the uterus by separating the vaginal fingers so that one goes to each side of the uterus. (Edgar—*Practice of Obstetrics,* The Blakiston Company.)
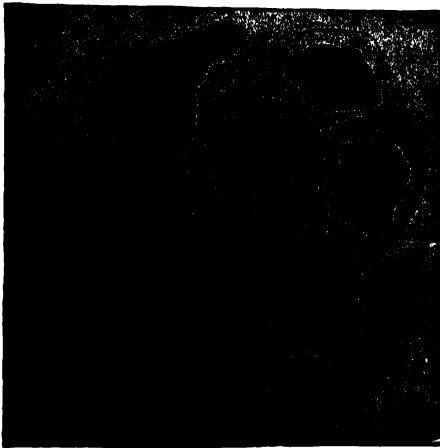
Fig. 219.

Fig. 220.

Fig. 219.—Hard nodules in the corpus uteri, due to small myomas. (Montgomery—*Practical Gynecology,* The Blakiston Company.)
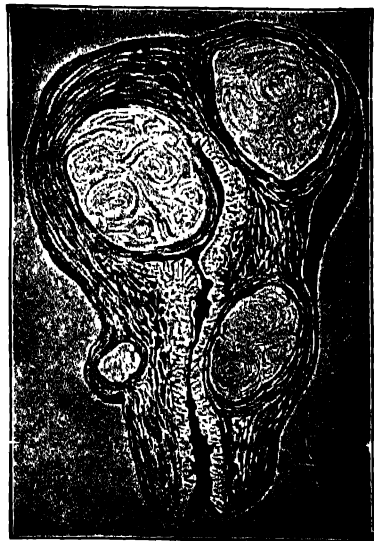
Fig. 220.—Larger myomas, in various situations in the uterine wall. (Schaeffer—*Hand-Atlas of Gynecology.*)

the cervix may be difficult to distinguish from a mass in the cul-de-sac (Fig. 214). Lateral displacement of the uterus may be due to a tumor pushing it or to old adhesions pulling it (Figs. 216, 217).

2. **Size** of Corpus Uteri. Is it apparently normal in size (about **three inches long**) or is it as large as the fist, or as large as a child's head? Fig. 218 indicates the method of palpating the margin of the uterus and also the method of determining its width by separation of the vaginal fingers.

3. **Shape** of the Corpus Uteri. Is it approximately pear-shaped and of regular contour, or is it distorted by myomas or other tumors (Figs. 219 to 224)?
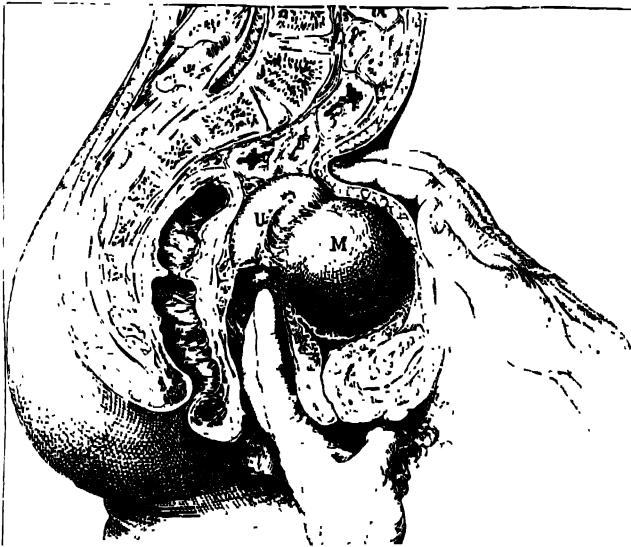
Fig. 221.—Method of determining how intimately a mass is attached to the uterus. Palpating the sulcus between the two. (Kelly—*Operative Gynecology*, D. Appleton-Century Company.)
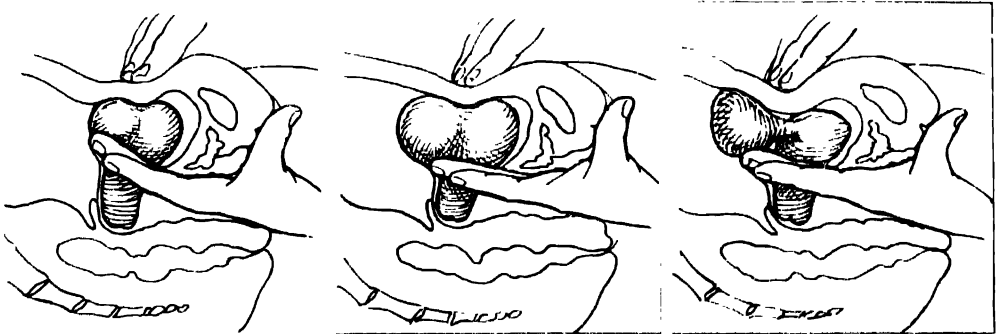
Fig. 222.   Fig. 223.   Fig. 224.

Fig. 222.—Bimanual examination, small nodule high on uterus.
Fig. 223.—Bimanual examination, large nodule high on uterus.
Fig. 224.—Bimanual examination, pediculated nodule high on uterus.

4. **Consistency** of Corpus Uteri. Is it apparently a firm, solid body or does it contain fluid, or are there hard nodules in it, or is there marked softening as in pregnancy (Figs. 225 to 228)?

5. **Tenderness** of Corpus Uteri. Does pressure on the uterus cause pain or does the attempt to move it cause pain?

6. **Mobility** of Corpus Uteri. Can the uterus be moved freely up and down, to right and left, forward and backward, or is it fixed more or less firmly by an inflammatory exudate or by a tumor?

Fig. 224A.—Identifying retrodisplacement of the corpus uteri. The corpus cannot be felt in front, and posteriorly it can be felt as a mass which is continuous with the cervix—that is, the cervix can be traced to the mass and seems to expand into it. (Netter—Sharp & Dohme Seminar.)

Fig. 224B.—Identifying enlargement of the corpus uteri. By tracing up the cervix as in Fig. 218, in front and at sides and back, the examiner determines that it expands directly into the mass. This identifies the mass as part of the uterus, in contradistinction to an extra-uterine mass. (Netter—Sharp & Dohme Seminar.)

Fig. 225.—A sectional uterus in early pregnancy, showing the two halves and the interior arrangement which gives Hegar's sign (Edgar, after Pinard—*Practice of Obstetrics*, The Blakiston Company.)
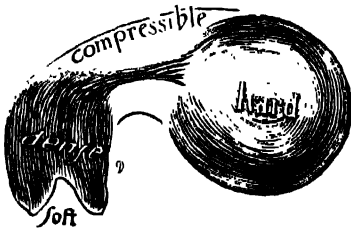
Fig. 226.—Showing the sensations imparted to the examining fingers by different portions of the uterus in early pregnancy, particularly the marked compressibility of the portion just above the internal os (Hegar's sign) (Dickinson—*American Textbook of Obstetrics*, W. B. Saunders Company.)
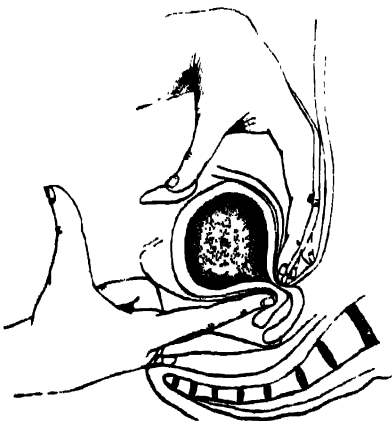
Fig. 227.—Palpating for Hegar's sign, with the uterus forward in the usual position. (Edgar—*Practice of Obstetrics*.)

Fig. 228.—Palpating for Hegar's sign, with the fundus uteri pushed backward, the abdominal fingers being in front and the vaginal fingers back of the cervix. (Williams—*Obstetrics*, D Appleton-Century Company.)

7. **Attachment** of Corpus Uteri. Does the uterus seem to be attached or fixed to the pelvic wall at some point? If so, where and by what?

In determining the various facts about the uterus, material assistance is given in some cases by separating the fingers laterally, as indicated in Fig. 218, or by separating them anteroposteriorly, placing one finger behind and the other in front of the cervix.

When a mass is found in the vicinity of the uterus, its exact relation to the uterus is to be determined as accurately as possible, particularly whether it is a growth from the uterus or is simply lying against that organ. Fig. 229 indicates the method of determining how intimately a mass is attached to the uterus. When it is impossible to reach the various parts of the uterus sufficiently to obtain the necessary information, the cervix may be caught with a tenaculum forceps and the uterus pulled somewhat downward as shown in Fig. 230.
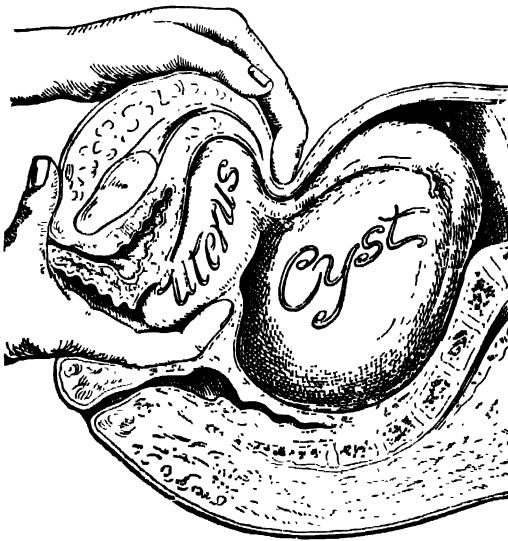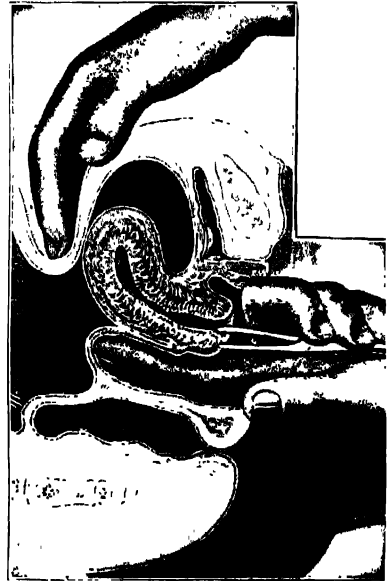
Fig. 229.   Fig. 230

Fig. 229.—Determining what attachment there is between the uterus and a mass back of it. The uterus is caught between the hands and brought forward, and the examining fingers are crowded in between the uterus and the mass. (Ashton—*Practice of Gynecology.*)

Fig. 230.—Drawing the uterus down with a tenaculum forceps to bring it within reach of the examining fingers. (Dudley—*Practice of Gynecology*, Lea and Febiger.)

PALPATION OF LATERAL REGIONS OF PELVIS

Tubes and Ovaries, Mass, Induration, Tenderness

In this region, on each side, lies the large area of connective tissue, beside the cervix and lower part of the corpus uteri. Here induration from inflammation or other cause is felt at once, low about the cervix, just under the vaginal wall. Higher, beside the uterus, lie the fallopian tube and the ovary. They are near the upper part of the broad ligament and so close together that ordinarily it is impossible to say, simply from the position of a mass there, whether it springs from the tube or from the ovary. Hence the region is

spoken of as the "tuboovarian" region, as both organs lie there. It is also called the "adnexal" region, the tube and ovary of each side being considered the adnexa of the uterus. The method of palpating in different conditions is indicated in Figs. 231 to 233. The tuboovarian region lies high and to palpate it satisfactorily requires special care.

Steps in Palpation of the Lateral Regions

In palpating the tuboovarian region of either side, proceed as follows:

1. Place the tips of the vaginal fingers to that side of the cervix, and then push them backward and outward and upward as far as possible.

In order to carry the finger tips sufficiently far into the posterior lateral area of the pelvis, it is necessary to push the perineum for some distance into the pelvis. This is best accomplished usually by utilizing the force of the body muscles, transmitted to the elbow either through the knee (Fig. 234), with the foot on a small stool, or through the iliac crest (Fig. 235). This leaves the arm muscles free for the deep delicate manipulation necessary to accurate palpation of the pelvic contents.
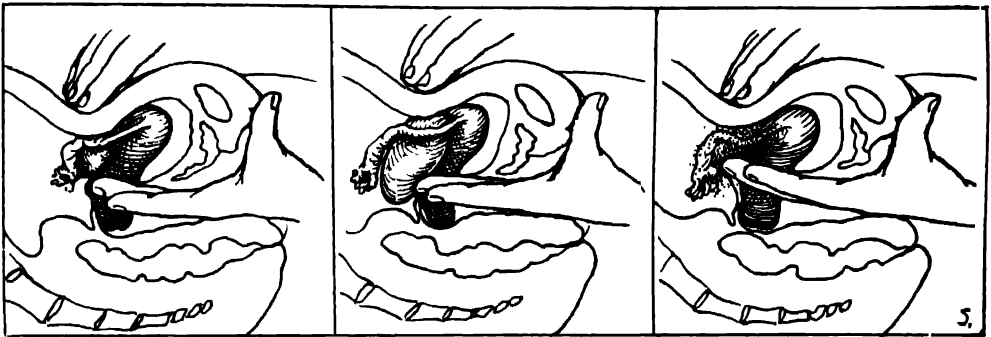
Fig. 231   Fig. 232.   Fig 233.

Fig. 231.—Bimanual examination, normal adnexa.
Fig 232 —Bimanual examination, distinctly outlined adnexal mass.
Fig. 233.—Bimanual examination, adnexal induration from infiltration.

2. With the abdominal fingers locate the anterosuperior spine of the ilium on that side and then bring the fingers directly inward (not downward toward the pubes, but directly inward or slightly upward) toward the median line for about two inches (Fig. 236).

3. Then, at that point, depress the abdominal wall into the posterior part of the side of the pelvis until the tips of the abdominal fingers come close to the tips of the vaginal fingers (Fig. 237). This brings the fingers near to each other **back** of, or at least in the region of, the tube and ovary.

4. If the adnexa are not felt in the back part of the pelvis, then bring the fingers of the two hands, held in the same relation to each other, slowly downward toward the pubes. In this way the tube and the ovary are made to pass between the examining finger tips and may be felt if decidedly enlarged.

- In these manipulations the palpation proper is made principally with the vaginal fingers, the abdominal fingers serving simply to push the structures down within reach of the fingers below.

Fig 234.—Invagination of the perineum and pelvic floor, the force being applied through the knee. The arrow indicates the direction of the force.

Fig. 235.—Another method of invaginating the pelvic floor. The force is transmitted through the iliac crest to the elbow as indicated by the arrow.

A **common error** is to bring the tips of the examining fingers together too close to the pubes (Figs. 238, 239); hence the palpation is of the tissue in front of the tube and ovary, even if they are in normal position. It must be kept in mind also that the tube and ovary are likely to be displaced, especially if diseased, and the displacement is nearly always backward; hence the importance of getting far back in the side of the pelvis when endeavoring to palpate these structures accurately.
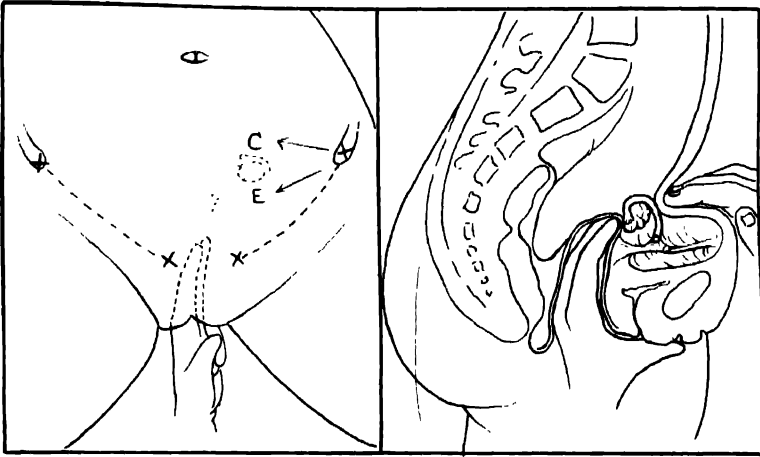
Fig. 236.   Fig. 237.

Fig. 236.- Steps in palpation of the left adnexa. C shows the correct starting point for the abdominal fingers, E shows erroneous starting position, causing fingers to miss adnexa, as shown in Fig. 239.

Fig. 237.—Bringing fingers together with ovary and tube between them.
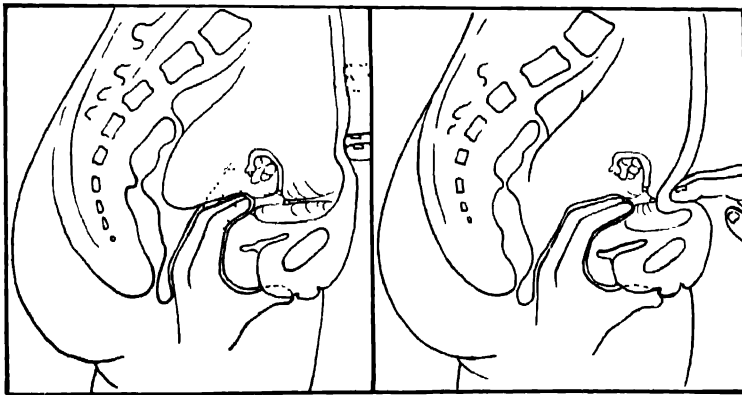
Fig. 238.   Fig. 239.

Fig. 238.—Illustrating common error. Starting abdominal fingers too close to the pubes and in front of the tube and ovary. Correct position of fingers shown in dotted outline.

Fig. 239.—Showing how the fingers come together in *front* of the ovary and hence miss that area.

In order to avoid this error, be certain that the point of depression of the abdominal wall is well above the tuboovarian region, so that when depressed into the pelvis it will lie back of the tube and ovary.

By proceeding gently, so as not to excite contraction of the abdominal muscles, and at the same time steadily pressing the two sets of fingers toward

each other, a little with each expiration, the finger tips may be brought almost together in the various parts of the pelvis. In order to succeed, however, the abdominal wall must be depressed at the right place (Fig. 240) and deeply (Figs. 241 and 242).

Facts to Determine

In the exploration in the tuboovarian region, take particular care to search for:

Tube and Ovary—Usually not felt if normal.

Abnormal Mass—Enlarged Tube or Ovary, Exudate, Tumor.

Induration—Inflammatory Infiltration or Exudate, Adhesions, Scar Tissue.

Tender Area—Normal Sensitiveness of Ovaries, Inflammation, Hyperesthesia, Tenderness from other cause.

Tube and Ovary.—In many cases the normal tube and ovary cannot be distinctly felt, even by the experienced examiner, and the inexperienced will find it difficult even in comparatively easy cases. When the tube or ovary is decidedly enlarged, it can be felt to slip between the examining fingers as a distinct thickening or as a small rounded mass.

After locating the adnexa, as above described, it is sometimes advantageous to try to trace the tube out from the uterus. The fundus uteri is located, the examining fingers (vaginal and abdominal making united counterpressure) pass to the upper outer angle, and then feel for the tube as it leaves the uterus and runs along the top of the broad ligament. The best place to locate it usually, when not abnormally indurated, is just beyond the angle of the uterus. It is a much firmer cord here than farther out where the cavity becomes large and the tube soft.

The normal fallopian tube may be felt in a suitable case (thin patient with relaxed abdominal wall and relaxed pelvic floor), in the position indicated, as a small soft cord about the size of a slate pencil. It presents very much the consistency of a piece of rubber tubing. It may, in a suitable case, be traced outward and is then lost in the region of the ampulla, where the tube becomes very soft and the ovary comes into prominence as a soft, rounded, movable body, a trifle larger than the end of the thumb and sensitive to pressure. When the tube is inflamed it is firmer and more easily felt. Usually, however, when the inflammation is at all severe, adhesions or plastic exudate surround the tube and ovary, binding them and the surrounding structures together in one mass and making their separate differentiation impossible.

If on examination the pelvic tissues are all soft and yielding, and no particular pain is caused by the palpation, you may be certain that the tubes and ovaries are not seriously diseased, though you may not have felt them.

Mass in Lateral Part of Pelvis.—The pelvic tissues, with the exception of the uterus, are soft and yielding, and any firm body may be felt through them, either a tumor or an inflammatory exudate or a firm blood clot. Fluid blood or serous exudate cannot be felt unless it is encapsulated. If a mass is found to either side of the uterus, determine concerning this mass the same facts that you did concerning the uterus—namely, its position, size, shape, consist-

Fig. 239A.—Palpating the adnexal areas. For the detailed steps, see Figs. 234 to 239. It is well to train the fingers of one hand for the difficult inside palpation, so that accuracy may be increased as additional examinations are made. Either hand may be used. Such use of the right hand is illustrated in these colored drawings. The authors of this textbook prefer the left hand, as indicated in the photographs in Figs. 240 to 242. In palpating the lateral areas it may or may not be possible to identify the ovaries definitely, depending on the thickness and tension of the abdominal wall and the size of the ovaries in that patient. (Netter—Sharp & Dohme Seminar.)
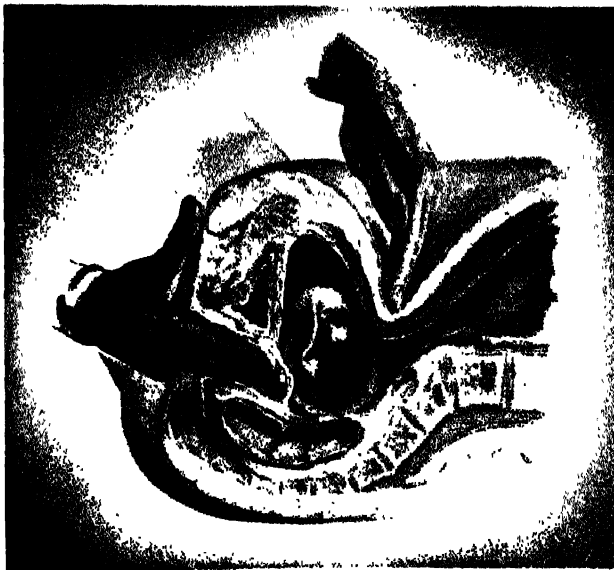
Fig. 239B.— Identifying a cystic tumor in the lateral area of the pelvis. Such a growth is usually from the ovary, but may come from the parovarium. A principal point in identifying a mass as adnexal rather than uterine, is the notch extending up between the mass and the uterus—that is, the cervix does not expand into the mass. (Netter—Sharp & Dohme Seminar.)

Fig. 240.   Fig. 241.

Fig. 240 — Palpation of the left lateral region. Placing the fingers of the abdominal hand. They should be on a level with, or a little above, the anterosuperior spine (indicated by the cross).

Fig. 241.— Palpation of the left lateral region. Depressing the abdominal wall deeply into the pelvis.

Fig. 242.—A view from another direction, showing the marked depression of the abdominal wall necessary in deep pelvic palpation.

ency, tenderness, mobility, and attachments. Determine particularly whether or not it is attached to the uterus, and, if so, whether by a broad attachment or by a narrow one.

Induration in the Lateral Part of Pelvis.—In some cases where there is no distinct mass felt, there is a very definite hardening of tissues at some point. Instead of the tissues being soft and pliable, and easily pushed before the examining finger, as they are normally, there is a stiffness and fixation and resistance, as though there were infiltration and thickening, and the structures beyond cannot be satisfactorily palpated. This resistance and fixation of tissue without a well-defined mass is designated by the term "induration." It may be due to infiltration (inflammatory, tuberculous, malignant) of the tissues, to inflammatory exudate on surfaces, to adhesions, to scar tissue, or to a tumor not yet developed far enough to form a distinct mass.

Tender Area in Lateral Part of Pelvis.—The ovaries are usually rather sensitive on bimanual palpation, and allowance must be made for this normal sensitiveness when estimating the diagnostic significance of tenderness in this region.

Tenderness on palpation may accompany almost any pathologic condition in the pelvis, but it is especially marked in inflammatory trouble, in peritoneal irritation from blood in the peritoneal cavity and in neuralgic affections of the pelvis.

PALPATION OF OTHER REGIONS

In the same way, as already described, careful exploration is made of the following regions:

> **Posterior Part of Pelvic Cavity**—Mass, Induration, Tenderness.
> **Anterior Part of Pelvic Cavity**—Mass, Induration, Tenderness.
> **Ureteral Regions**—Mass, Induration, Tenderness.
> **Pelvic Nerve Trunks**—Tenderness.
> **Lower Abdomen**—Tension, Tenderness, Mass.

If a mass is found in any of these regions, determine as accurately as possible its position, size, shape, consistency, tenderness, mobility, and attachments. The anterior rectal wall is applied closely to the posterior vaginal wall. Turn the examining fingers so that the palmar surfaces are directed backward, and palpate the rectum. Fecal masses in the lower part of the rectum cause no trouble in diagnosis, for in that location their character is easily recognized. In the upper part of the rectum, however, and in the sigmoid region such a mass may cause confusion in diagnosis, for it may resemble a prolapsed ovary or an inflammatory mass in the cul-de-sac or about the tube.

The distinguishing characteristics of a **fecal mass** are three: (a) it is not particularly tender, (b) it is usually of puttylike consistency and may be dented, the dent remaining, and (c) it may sometimes be pushed along to a different position in the bowel.

The method of determining whether a mass is attached to the posterior surface of the uterus, and, if so, how intimately, is shown in Fig. 229, where the sulcus between the uterus and the mass is being palpated to determine its depth. In the case of a tumor with a long pedicle, it is well to have an assist-

ant hold the tumor up in the abdomen out of the way, while the examiner, by bimanual palpation, feels whether or not there is any connection with the uterus or appendages. Also, the uterus may be caught with a tenaculum forceps and pulled downward (Fig. 230), assisting still further in palpation. Another point is that in the case of a broad attachment to the uterus the mass and uterus move as one body, whereas with a slender attachment the two may be moved separately.

The bladder and other tissues in front of the uterus should be palpated to determine whether there is any mass or any marked tenderness.

The region of the ureter on either side is an interesting area which is usually overlooked in pelvic palpation. The ureter extends on each side from the base of the bladder backward, outward and upward, about half an inch from the cervix uteri. Ordinarily it is not felt. In a suitable case, however,
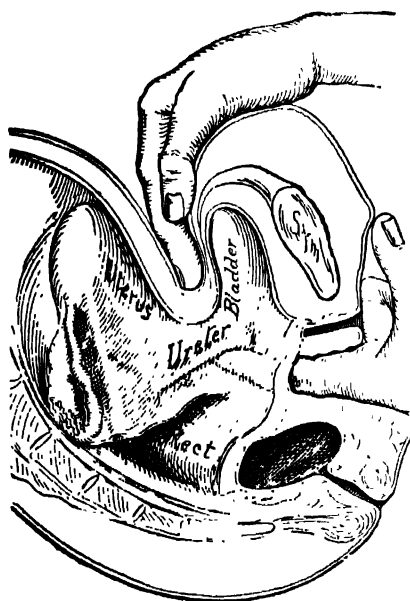
Fig. 243.
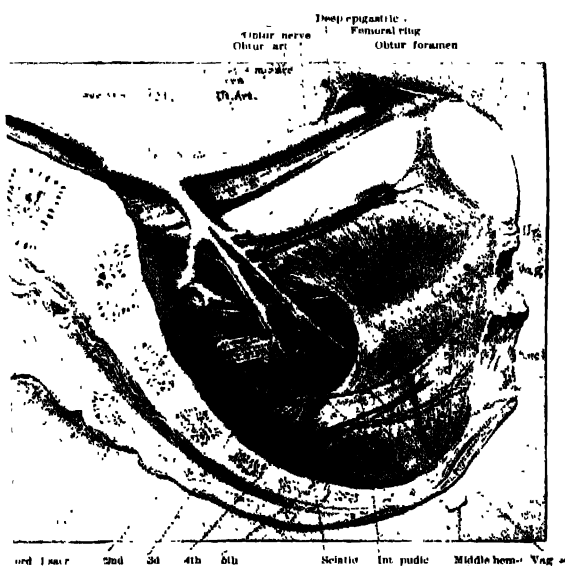
Fig. 244.

Fig. 243.—Palpating the region of the right ureter. (Ashton—*Practice of Gynecology*.)

Fig. 244.—Showing the exact situation of the large nerve roots in the pelvis. In the illustration they appear a shade darker in color than the other structures. (Kelly—*Operative Gynecology*.)

it may be felt as a rather indefinite cord or line of tension, extending from the base of the bladder in the direction indicated. Fig. 243 indicates the method of palpating this region. If inflamed, the ureter is tender on pressure. If infiltrated and thickened, it is easily felt. If a stone is lodged in the lower portion of the ureter, it may be felt. In this way one of the authors was able to determine that a stone was lodged in the left ureter, a short distance from the bladder, in the case of a pregnant woman with such sudden severe pain and threatening symptoms that it was at first feared that the trouble was a rupture of an extrauterine pregnancy. The patient eventually recovered and carried the child to term.

If much inflammation has taken place about a stone or an infected portion of the ureter, there may be considerable periureteral infiltration that in a measure obscures the ureter, and gives the signs simply of a cellulitis at that side of the uterus and extending toward the bladder. A cellulitis associated with persistent bladder symptoms should be carefully investigated, with the idea that it may come from the ureter. Determine whether the induration runs into the region of the ureter and whether there is tenderness farther up along the ureter or in the kidney.

In cases where pelvic neuralgia or neuritis is suspected, palpate the pelvic nerve trunks (Fig. 244). Sometimes the pelvic tenderness, which at first seems widespread, may be localized in its greatest intensity along the nerve trunks of one or both sides. These may be reached by deep palpation per vaginam or per rectum.

Trained Touch

The authors desire to emphasize the importance of training the fingers to appreciate differences in the feel of tissues and training the mind to interpret the diagnostic significance of the differences felt. The multiplication of instruments and laboratory aids to diagnosis has to some extent obscured the importance of the educated touch. Though these aids are helpful, and necessary in many conditions, they cannot substitute for trained palpation in deep-seated pelvic disease.

The beginner must learn to read the conditions first by learning the separate letters, so to speak, and then learning what certain groupings of letters mean. The separate items that must be recognized in this examination are the **position, size, shape, consistency, tenderness, mobility,** and **attachments** of the organs. This takes much time and patience and well-directed efforts through many examinations. It cannot be learned from lectures. It cannot be learned by seeing someone make examinations and applications. It can be learned only through repeated bimanual examinations by the student himself, under competent instruction. Hence the importance of the clinical portion of a gynecologic course.

Though it takes considerable time to learn to recognize normal conditions, the time is well spent, for no real progress is possible without this knowledge. The **normal must be known** before the abnormal can be appreciated. This is self-evident and yet how many students at graduation, and physicians long after graduation, find it difficult to feel more than the vaginal walls and cervix.

In the recognition of pathologic masses, the same points must be considered (position, size, shape, consistency, tenderness, mobility, and attachments), and this information, supplemented by the history and other aids, determines the diagnosis.

SPECULUM EXAMINATION

By means of certain instruments the vaginal walls may be spread apart so that those walls and the cervix uteri may be seen. Information of much value in some cases may be obtained in this way.

Instruments for Regular Speculum Examination

The instruments needed for this examination are shown in Fig. 245. They are as follows:

A speculum for separating the vaginal walls.

A long dressing forceps for sponging out the vagina, usually called "Uterine Dressing Forceps."

A tenaculum forceps, or "Volsellum," for catching the cervix and bringing it better into view.
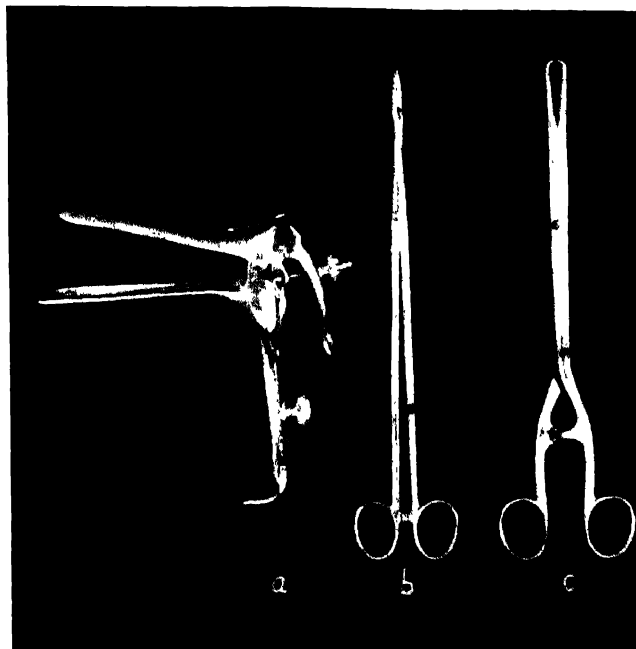
Fig. 245.   Fig. 246.

Fig. 245.-- Instruments for the speculum examination. *a.* Bivalve speculum, of which it is well to have three sizes—large, medium, and small. *b.* Dressing forceps for swabbing out vagina. *c.* Tenaculum forceps for catching cervix to bring it well into view.

Fig 246.—Introducing the bivalve speculum First step—depressing the perineum to give room for the speculum to be introduced

Vaginal Speculum.— The **bivalve speculum** (Fig. 245, a) is the kind most frequently used in ordinary office work. It consists of two blades, which are introduced closed and then opened by a mechanism at the handle. The vaginal walls are thus held apart and a very good view of the walls and cervix may be obtained. The bivalve speculum is convenient and gives good exposure of the cervix in most cases.

There are many different modifications of the blades and also of the mechanism for separating the blades. The most satisfactory form that the authors have found is shown in the illustration. It is called the Graves speculum and has the advantage that it can be easily and quickly transformed into a fairly satisfactory Sims' speculum, which is a decided convenience in office work. **Three sizes** are useful—small (virgin), medium, and large. The cervix is easier exposed in most cases if the anterior blade of the speculum is somewhat shorter than the posterior.

Some specula are made with three blades, instead of two, constituting a trivalve speculum. They are made on the same general principles as the bivalve but the mechanism is more complicated and, usually, without corresponding benefit.

The bivalve speculum is used with the patient in the dorsal posture.

The **Uterine Dressing Forceps** (Fig. 245, b) is a long strong forceps for sponging out the vagina and for making vaginal applications. It may be straight or curved as preferred. The authors find the forceps with a straight shank and a slight curve near the end more convenient than the much curved instrument. A vaginal depressor for pushing the vaginal wall out of the way is usually mentioned in an examining set, but it is generally not necessary, as the vaginal wall may be pushed aside sufficiently with the dressing forceps.

The **Uterine Tenaculum Forceps** may be needed for catching the cervix to bring all parts of it into view. It should be light but strong, especially about the lock, where it is likely to work loose (Fig. 245, c).

Fig. 247.

Fig. 248.

Fig. 247.—Introducing speculum. It has been carried part way in. Notice the oblique position, which prevents painful pressure on the urethra.

Fig. 248.—The speculum carried all the way in and turned into-position for opening.

Steps in the Regular Speculum Examination

Introducing the Speculum.—The blades of the speculum are closed and the outer surfaces lubricated and the speculum held in the right hand, while with the other hand the labia are separated and the perineum depressed somewhat with one finger (Fig. 246). The speculum is then introduced and carried all the way to the upper end of the vagina without being opened. In most cases the speculum passes the vaginal entrance most easily when held with its width almost vertical, the edge being held just far enough to one side to **miss the urethra** (Fig. 247). When well within the vagina, it is turned transversely and carried in as far as it will go (Fig. 248).

Exposing the Cervix.—After the blades have been introduced well up to the top of the vagina, they are opened and the cervix and vaginal walls exposed (Fig. 249). By turning the speculum in various directions, all parts of the cervix and upper end of the vagina may be seen. If the cervix does not come well into view, it may be caught with a tenaculum forceps and brought downward somewhat and turned from side to side, exposing all portions of it and of the vaginal vault.

Information Obtained in the Speculum Examination

The information sought in the speculum examination is obtained by inspection of the following structures:

Vaginal Walls —Color, Discharge, Redundancy.

Cervix Uteri— Position, Color, Size and Shape, Lacerations, Deviation of Axis, Eversion, Erosion, Hypertrophy, Cystic Change, Ulcer.

External Os— Size and Shape, Color of Edges, Discharge, Polypi.

Fig. 249.— Bivalve speculum in place. Sectional view, showing relations of speculum and exposure of the cervix and vaginal vault by opening the blades.

Vaginal Discharge

If there is discharge, determine whether it comes from the uterus or originates in the vagina. If from the uterus and of a stringy mucous character, it comes largely from the cervix. Discharge from higher in the uterus (endometrium) lacks the tenacious character of the cervical mucus.

Normally the mucosa of the cervical canal secretes a small amount of clear mucus which blocks the canal and protects the vulnerable endometrium above from bacterial invasion. This clear mucus coming into the vagina mixes with the exfoliated epithelial cells, forming the small amount of whitish *muco-epithelial discharge* which constitutes the normal vaginal contents. This normal discharge occupying the vaginal canal is distinctly protective, in that it halts spontaneous invasion by pathologic organisms from outside and even when such organisms are carried into the vagina it discourages their growth. In-

vestigations as to the cause of this protective quality of the normal vaginal contents brought some interesting facts, as follows:

a. The normal vaginal discharge contains large nonpathogenic bacilli (Doederlein bacilli) which live on the glycogen contents of the exfoliated epithelial cells, and in so doing form acid which maintains the normal acidity.

b. Any considerable diminution of the normal vaginal acidity favors the growth of pathogenic bacteria and protozoa which flourish in alkaline or less acid media. The resulting inflammation gives rise to various types of pathologic discharge, even causing blood-tinged discharge at times. The growth of pathologic organisms diminishes the glycogen contents of the epithelial cells, which in turn checks the growth of the normal protective bacilli (both by diminishing the glycogen on which they feed and decreasing the acidity, which discourages their growth). When this vicious circle is once established, it is likely to continue with increasing disturbance until nature's efforts at restoration are aided by appropriate treatment.

c. Effective treatment restores normal vaginal acidity and normal epithelial cells (glycogen) and Doederlein bacilli, and eliminates the pathogenic organisms. This is accomplished by washing out the mass of invading organisms with a douche, which may contain acidifying material, and supplying in good quantity some form of sugar on which the normal bacilli may feed until they again become numerous enough to split sufficient cell glycogen for maintaining normal acidity. The details of such treatment are given under Vaginitis, in Chapter IV.

d. The factors in the origin of vaginitis and in its cure vary greatly in different cases, the variations involving different organisms, relative virulence, and the state of the patient's physiological activities. On the last point it is interesting to note that the maintenance of glycogen in the epithelial cells depends on an adequate supply of ovarian hormones.

e. The intractable character of vaginitis in children and in the aged is due largely to the absence of ovarian activity and ovarian hormones at those periods of life. When this was discovered and suitable endocrine medication given, the resistant character of the vaginitis disappeared. Lowering of general nutrition and metabolism in various ways may be a factor in the onset or persistence of pathological conditions here as elsewhere.

f. The reaction of the vaginal contents, as to acidity or tendency toward alkalinity, may be taken as a fair index as to normal or pathological character, and as a rule the greater the progress toward alkalinity the more marked the pathological disturbance. Progress toward alkalinity is measured in terms of the chemical symbol pH, which signifies a certain hydrogen ion concentration, and increasing pH means increasing alkalinity, as indicated by the increasing stippling on the scale in Fig. 250. Extensive studies have shown that with normal contents the range of reaction is pH 3.8 to 4.4. Beyond that the discharge becomes pathological, different levels favoring the growth of different organisms as shown in the illustration.

Ways have been devised of measuring the pH of the vaginal contents (mixed contents and also at upper and middle and lower portions of vagina). Some of these methods will be given later under special examination measures, to be used when needed in refractory cases or for other investigative work.

While measuring the pH accurately was essential to the important investigations which established the relations illustrated, the establishment of those facts enables diagnosis and effective treatment in most cases without the necessity of pH measurements. In fact, the matter has been so well worked out that the reading of the chart may be turned around—that is, the clinical establishment of trichomonas vaginitis (symptoms, character of discharge, smear showing trichomonads) indicates about pH 5-6, loaded streptococcic or staphylococcic fields about pH 6-7, and active gonorrhea about pH 7-8. In this connection it must be kept in mind that the cervical mucus is alkaline and must be acidified by the vaginal physiological activity before the mixed contents present the normal pH reading. This makes clear that in accurate investigative work involving the pH it should be registered at different parts of the vagina.
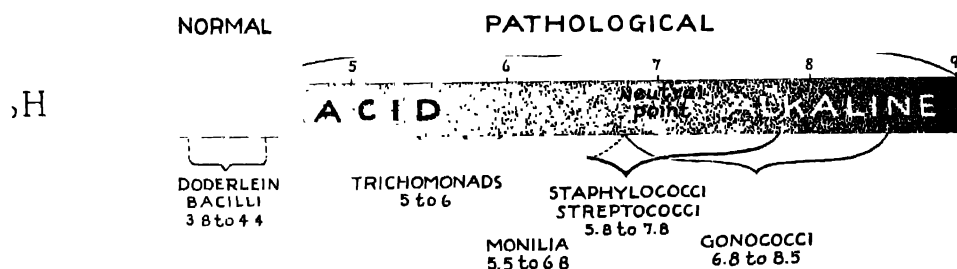
Fig. 260.—Diagram indicating the variations in the pH of the vaginal contents, and also the pathogenic organisms which flourish at different stages of alkalinity. (Modified from G. D. Searle & Company.)

Microscopic Features

The microscopic examination of the vaginal discharge serves to identify the predominating type of cells present and also in most cases the pathogenic organism if any.

Preparing the Slides. A small drop of warm water is placed on a slide near one end, a little of the discharge is mixed with it and it is then covered with a coverglass. This fresh or live slide is for examination for trichomonads. Incidentally, the reduced light used to bring out the outlines of the protozoon brings out the outlines of epithelial cells and cell nuclei and also of branches (mycelium) and buds or spores of yeast and other fungi.

Slides for staining may be made at the same time, if such are desired. A small amount of discharge is placed on a slide near one end, the end of a second slide is placed on it, and then the two are drawn apart, leaving on each a film or smear. This maneuver gives a thin film, which is better than a thick one for a stained specimen, and it gives two films of the same portion of discharge, which is advantageous when examination of the blue-stained smear shows forms suspicious of gonorrhea and it is desired to make gram decolorization of a similar smear and compare.

Examining the Slides. The "warm" slide or live slide is all ready to be placed on the microscope stage for examination. It is examined first with the low power, for focusing and picking out special fields, and then the nosepiece is turned to the medium high power for study of individual epithelial cells and

protozoa and fungi. The light-diaphragm is stopped down sufficiently to show the outlines of clear bodies, such as epithelial cells and trichomonads.

Cellular Elements. The normal cellular elements in the age of active ovarian functioning (between puberty and the menopause) are quite different from those before puberty and after the climacteric decline of ovarian function. The various normal types are described and illustrated under Physiology in Chapter I.

Estrogen deficiency is indicated in the accompanying illustrations, the gradual loss of ovarian function being well shown by the changes in the vaginal contents. Contrasting the normal estrogen picture (Fig. 251) with starting estrogen deficiency (Fig. 252) modification of the large epithelial cells is seen. In Fig. 253 the large epithelial cells divide the field with the smaller "atrophy" cells, while in Fig. 254 "atrophy" cells and leucocytes have taken the field.

Fig. 251.   Fig. 252.

Fig. 251.— This type of vaginal smear indicates normal estrogen effect. The cells are large and flat, the edges are clean cut and the nuclei are small (pyknotic). No "atrophy" cells are present. Smear taken on eighteenth day of cycle from young woman, aged twenty-three years, with normal, regular menstrual cycles.

Fig. 252.—Beginning estrogen deficiency. Smear taken from patient aged forty-three years, ten months after spontaneous menopause. The cells are somewhat smaller than those in Fig. 251, less regular in shape, less flattened, margins not so clean cut, and nuclei are larger—that is, the cells are less advanced in the process of cornification, flattening of cell and shrinking of the nucleus, which mark the normal exfoliation of full estrogen effect. (Geist and Salmon—Am. J. Obst. & Gynec.)

If inflammation be present at any age, pus cells (dead leucocytes) are massed in the microscopic picture, the extent of the massing of pus cells depending on the intensity of the pathologic process. In addition, protozoa (usually trichomonads) or fungi (mainly monilia) may be found. The distinguishing features of each are described in detail under that disease in Chapter IV.

With fresh or live smears a coverglass is used to slow evaporation, thus preserving cell forms and trichomonad activity as required for ordinary exami-

nation. When longer study of the organisms is required, as in special investigations, evaporation may be still further slowed by employing the hanging drop.

Bacterial Elements. Staining the Slide. When abundant, bacteria may be dimly seen in the plain slide by the refracted light used in outlining the larger cellular elements, but for bacterial examination it is necessary that the slide be stained. The film is first allowed to dry. Then the slide is passed two or three times through a flame (Bunsen gas flame or alcohol lamp) to fix the film on the slide so it will not wash off. The film may be stained by flooding for fifteen seconds with a weak solution of any of the commonly used aniline dyes. A 1 per cent solution of methylene blue is the one usually employed. Enough is dropped on to cover the film and, after the required time, is washed off in running water, and the excess water is removed gently with blotting paper. The

Fig. 253   Fig. 254

Fig. 253.—Moderate estrogen deficiency Smear from patient aged forty-eight years, four years after bilateral ovariectomy Note the appearance of small epithelial cells ("atrophy" cells), which divide the field with the large cells of the preceding slide.
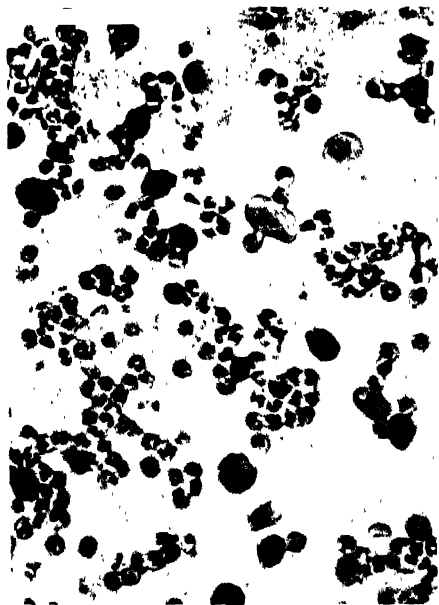
Fig. 254.—Advanced estrogen deficiency. Smear from patient aged fifty-nine years, nine years after the menopause. "Atrophy" cells and leucocytes have taken the field There are none of the large epithelial cells characteristic of estrogen effect. (Geist and Salmon—*Am. J. Obst. & Gynec.*)

film is allowed to dry, and is then ready for the microscope. Examination may be made first with a medium high power objective for general orientation, and then a drop of oil is placed on the film and more detailed examination is made with the oil immersion objective. No coverglass is needed, and if one be used it may prove too thick to allow proper focusing of the oil immersion lens.

Vaginal Walls.— Are the walls of normal color or is there congestion? If congestion, is it active or passive? If the walls are bright red, that means active or arterial congestion and is due to inflammation or irritation. If the walls have a bluish tinge, that means passive or venous congestion and indicates either pregnancy or some interference with the circulation, as by a pelvic tumor or exudate or by failure in compensation in heart disease.

Small punctate bleeding areas on the vagina, without large ulceration, are due usually to severe inflammation of the trichomonas or monilia type, or in older women to atrophic (senile) vaginitis.

Cervix Uteri.--- Is the cervix in low position, so that it is easily exposed when the speculum is in but a short distance, or is it higher than normal, so that it cannot be well exposed with the speculum of ordinary length? Is the color normal or is there congestion, either active or passive? Here, as in the vaginal wall, active congestion means inflammation or irritation, and passive congestion indicates either pregnancy or obstruction of the circulation. A bright red area extending a considerable distance out from the os is usually due to eversion or erosion.

Is the axis of the cervix directed ACROSS the vagina, as it should be normally, or ALONG the vagina, as in retrodisplacement of uterus or anteflexion of cervix?

External Os.---The size and shape show whether or not there has been laceration and consequently are of considerable medicolegal importance in certain cases, because they furnish strong evidence for or against a previous childbirth.

Different appearances of the normal cervix are shown in Figs. 255 to 258. Fig. 259 shows cervicitis with free discharge of tenacious mucus. The cervix in Fig. 260 shows laceration and erosion in addition to discharge. Laceration, erosion, and cyst formation are shown in Fig. 261. Types of lacerated cervix, with the various shapes resulting, are shown in Figs. 262 to 269. There is normally a clear, sticky, tenacious mucus in the cervix and about the external os The first effect of inflammation is to make this more abundant and later it becomes mixed with pus. As long as the cervical inflammation is a prominent part of the process, the tenacious, stringy quality will be a prominent feature of the discharge. If there is any suspicion of gonorrhea, make a spread of the discharge for microscopic examination. If desired, discharge in the uterine canal may be withdrawn for diagnostic or therapeutic purpose with a suction bulb and tube.

Occasionally a polypus will be seen presenting at the external os or hanging by a pedicle.

Difficulties in Speculum Examination

Poor Light.---If the light is so poor that the cervix and upper portion of the vagina cannot be seen, an ordinary flashlight is helpful or, if that is not available, a head mirror may be used to reflect light from any source into the vagina. Also, there are now available small electric lights to use in the speculum, and even specula with lights incorporated.

Painful Abrasions.---If there are painful abrasions or fissures about the vaginal orifice which interfere with the examination, the sensitiveness may be diminished by the application of a small piece of absorbent cotton soaked in a 10 per cent cocaine solution. Leave this in place for from three to five minutes, then remove it and proceed with the examination.

Redundant Vaginal Walls.---When the vaginal walls are very lax and redundant, as sometimes occurs because of subinvolution following labor, they collapse about the speculum in such a way as to hide the cervix. This

difficulty may in some cases be overcome by using a longer speculum. When this does not expose the cervix satisfactorily, the redundant walls may be held out of the way by the use of a rubber sleeve over the speculum, as shown in Fig. 270. Another method of overcoming the difficulty is to put the patient in the Sims posture and use the Sims speculum
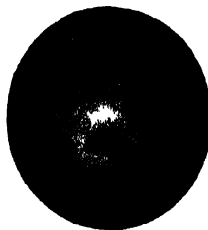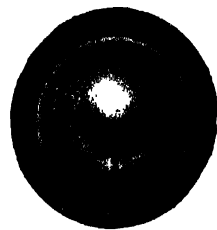
Fig. 255.　　　　　　　　Fig. 256　　　　　　　　Fig. 257.

Figs 255 and 256.—Varieties of normal cervix in the virgin. Fig. 257, Cervix of multipara.
(Norris, after Heitzmann—*American Text-Book of Obstetrics.*)
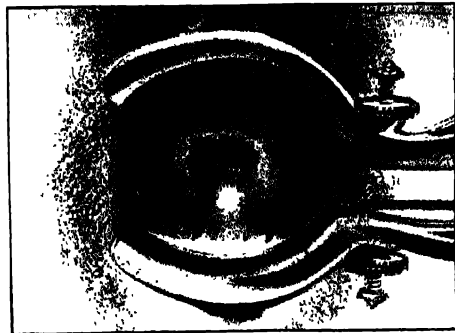
Fig. 258.　　　　　　　　　　　　　　　　Fig. 259.

Fig. 258.— A senile cervix, with upper part of vagina. (Edgar— *Practice of Obstetrics.*)
Fig. 259.—Discharge from the cervix uteri, as seen through the speculum. (Massey—*Conservative Gynecology.*)
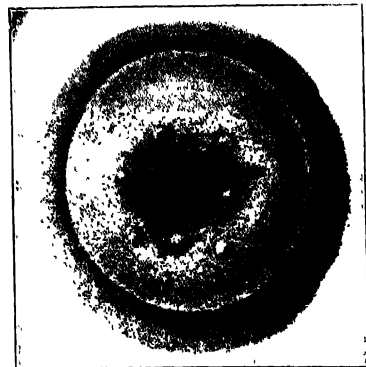
Fig. 260.　　　　　　　　　　　　　Fig. 261.

Fig. 260.—Discharge, with laceration and erosion of the cervix. (Massey—*Conservative Gynecology.*)
Fig. 261.—Erosion of the cervix, with a few scattered cysts. (H. MacNaughton-Jones— *Diseases of Women.*)

Examination With Cylindrical Speculum

The cylindrical speculum consists simply of a tube with the outer end flaring and the inner end cut obliquely. It may be made of metal or hard rubber or glass. The cylindrical speculum is useful in certain forms of treat-
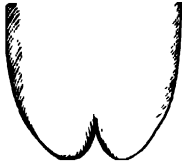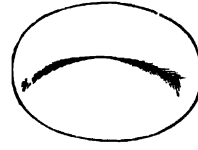
Fig 262. Fig. 263.

Figs 262 and 263.—Side and front views of a simple bilateral laceration, requiring no treatment.
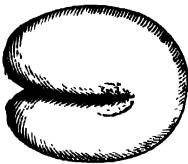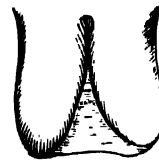
Fig. 264 Fig. 265

Fig. 264.—Front view of a unilateral laceration requiring no treatment.
Fig 265—Side view of a unilateral laceration. Such a laceration may cause abortion in he early months of pregnancy.
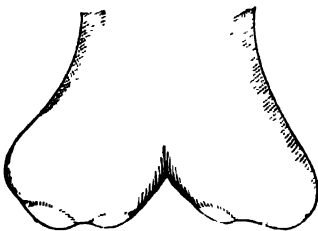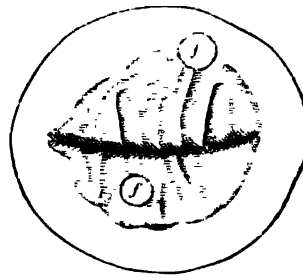
Fig. 266. Fig 267

Fig. 266 --Side view of a bilateral laceration, requiring treatment. The lips are everted, and the Nabothian follicles stand out as small hard lumps.
Fig. 267. --Front view of a bilateral laceration, showing eroded area and Nabothian follicles.

Figs. 262 to 267—LACERATIONS OF THE CERVIX UTERI. (Baldy—*American Textbook of Gynecology*)
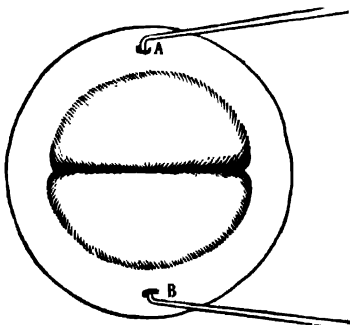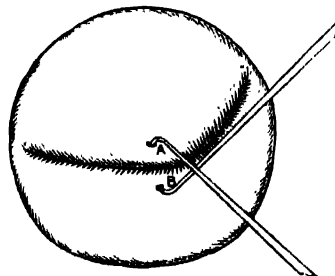
Fig. 268. Fig. 269.

Figs. 268 and 269.---Testing for the extent of the tear, in cases where the cervix has the appearance of a ball. The center of the anterior lip (*A*, Fig. 268) and of the posterior lip (*B*) are each caught with a tenaculum and brought together, as indicated in Fig. 269. (Baldy—*American Textbook of Gynecology.*)

ment, particularly when it is desired to apply to the cervix medicines from which the vaginal walls should be protected, but it is not much used in examination work.

When in the examination of a girl it is necessary to inspect the cervix, this may be accomplished without disturbing the hymen by use of a small cylindrical speculum for which Kelly's cystoscopic tubes do very well. Light may be furnished by a flashlight or a head mirror or a miniature electric light in the speculum.

Examination With the Sims Speculum

The Sims speculum is a perineal retractor, and for use requires the patient to be put in the Sims posture. Like any other retractor, it must be held in place either by an assistant or by a mechanism (speculum holder), of which there are several varieties.
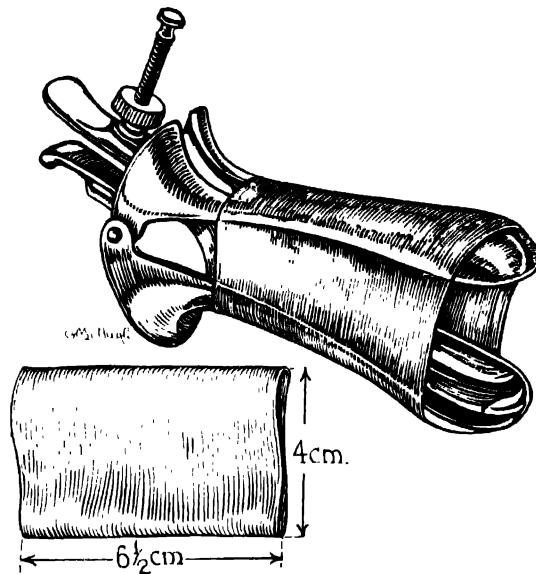
Fig. 270.— Device to improve specular examinations, consisting of bivalve vaginal speculum with a section of Penrose drain used as a sleeve. (Tucker—*J. A. M A.*)

The **Sims Speculum** consists of a blade, somewhat resembling a duck's bill, and a handle. As usually made, two blades are placed on one handle, a large blade at one end and a small blade at the other (Fig. 271). A further improvement is a flange near the larger blade (Fig. 272). This flange holds the fleshy part of the right buttock up out of the way. The Graves bivalve speculum, mentioned above, is easily and quickly changed into a satisfactory Sims speculum (Fig. 273), so it is not usually necessary to buy a special Sims speculum.

The Sims Posture.—The principal points about the Sims posture, called also "left lateral posture" and the "semiprone posture," are as follows:

1. All constriction must be removed from around the waist.

2. The patient lies on her left side, with left arm and hand behind her and the front of the chest turned toward the table as far as possible without discomfort. When in proper position, the upper part of the body rests on the left breast.

3. The hips rest near the lower left corner of the table and the body extends diagonally across the table toward the right side.

4. The left thigh is drawn up so that it forms an acute angle with the body, and the right thigh is drawn up still more, and allowed to drop over the lower one. This puts the patient in the position shown in Figs. 274 and 275, and it permits the abdominal wall and the intestines and uterus to fall forward.

Use of Sims Speculum.- To introduce the speculum, the right labia are raised, thus exposing the vaginal opening, and then the speculum point, well lubricated, is carefully worked into the opening. At the same time, the perineum is pulled somewhat backward with the speculum point, in order to give more room for the point to slip in (Fig. 276). The blade is then carried all the way in. The speculum is then grasped firmly and pulled backward, thus retracting the perineum and exposing the interior of the vagina (Fig. 277).
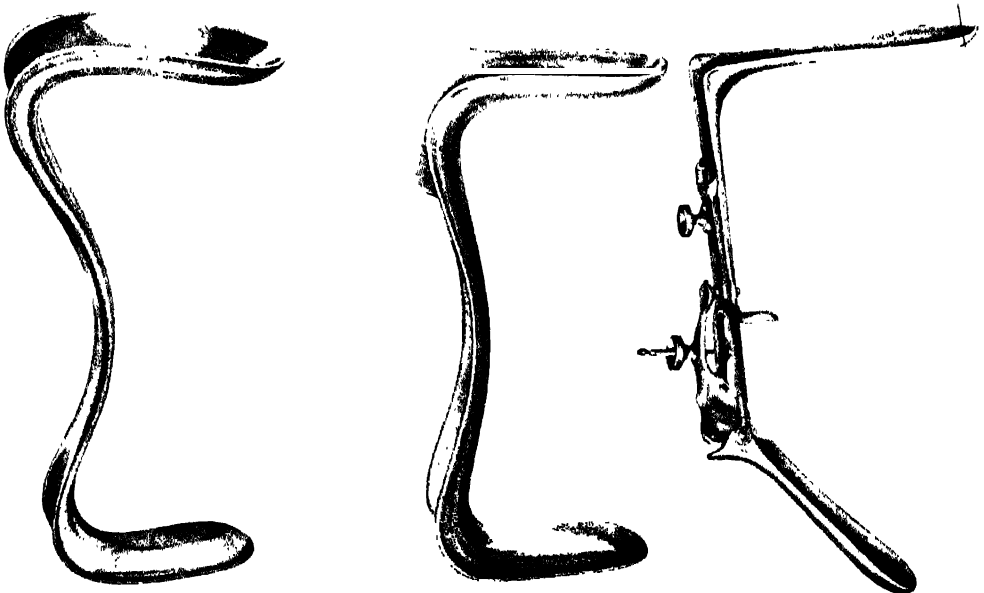
Fig 271   Fig 272   Fig. 273.

Fig. 271.—Sims' speculum, two blades of different sizes attached to one handle.
Fig. 272.—Flange attached to one blade to hold back buttocks.
Fig. 273.—Graves' bivalve speculum changed to the Sims type.

As the speculum is introduced, the vagina becomes distended with air, and when the perineum is retracted the cervix and anterior vaginal wall may be seen. To bring the cervix into still better view, catch it with the tenaculum forceps and bring it slightly toward the opening.

When Indicated.—The Sims speculum with the Sims posture is of decided advantage in the following conditions:

When the bivalve speculum fails to expose the cervix satisfactorily. This may be due to the vaginal walls being so lax that they fall about the blades and obscure the cervix, or it may be due to the vaginal opening being so small that the blades cannot be sufficiently separated. Again, in some cases of inflammation of the uterus or about the uterus, the bivalve speculum cannot be opened sufficiently because the anterior blade causes pain by pressure on the

inflamed structures. When examining or treating a lesion in the posterior vaginal fornix that is difficult to expose with the bivalve speculum, the employment of the Sims speculum and Sims posture may aid.

Securing Adequate Specimen From Cervix

There has been a marked advance in the handling of chronic inflammatory conditions about the cervix, whether or not there be suspicion of malignancy.

Fig 274.   Fig. 275

Fig 274.—Patient in Sims' posture. Notice how the upper knee drops over the under one.

Fig. 275.—View from above, showing the arm behind the patient. (Dickinson—*American Textbook of Obstetrics*.)

The improved method consists of effective treatment of the chronic cervicitis, along with the obtaining of the specimen. This is accomplished by excising the whole affected area in the cervix. The patient is sent to the hospital so that the cervical conization and the usually needed endometrial curettage can be carried out in a thorough way. The excision of the area of chronic cervicitis may be made by conization with the electric cutting wire or by conical excision with the knife. The former is preferable where the proper current machine is at hand, for the latter entails more bleeding and extensive suturing.

This therapeutic handling of the chronic cervicitis removes that menace, and puts the cervix in good condition. At the same time it gives an adequate

specimen comprising all the area affected. Microscopic examination of such a specimen settles the question of malignancy. If no malignancy is found in the cervical and endometrial tissues the patient returns home with the uterus in good condition, and we have no further misgivings as to what process may be going on in it.

Contrast this thorough treatment of chronic cervicitis with the old procedure of excising a small specimen for the pathologist and, if no malignancy is found, allowing the process in the cervix to go on, and after a while when another area becomes suspicious excising another small specimen—and so on until malignancy finally develops in the area of persistent irritation. General

Fig. 276.   Fig. 277.

Fig. 276.—Introducing the Sims speculum.
Fig. 277.—Speculum in place, and showing also the method of holding it and of keeping the upper buttock out of the way.

adoption of the improved plan of handling chronic cervicitis and other irritative conditions about the cervix will go far toward prevention of cancer of the cervix and the diminution of deaths from that disease.

In explaining the proposed treatment to the patient, it is well to put it altogether on the therapeutic basis, the diagnostic side being touched on only as necessary to answer questions or prevent postponement of treatment. The sinister thought that she may have a cancer is easy to arouse in a patient but very difficult to quiet, hence any unnecessary intimation in that direction is to be avoided. The patient is sent to the hospital for removal of the chronic inflammation—and if no malignancy is found she may never know that cancer

was suspected, thus being spared unnecessary worry. If the patient asks about the possibility of malignancy, explanation is made that as a matter of routine all tissue removed is checked over microscopically.

Of course, a polyp with a small pedicle may be twisted off or a projecting piece of tissue clipped off in the office with cutting forceps (Fig. 278). Such
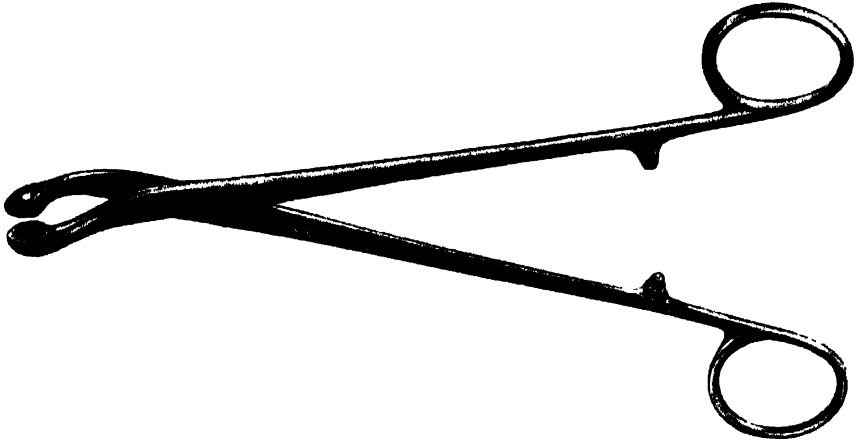
Fig. 278 - Gaylor's scissors for the removal of small projecting pieces of cervical tissue for microscopic examination.
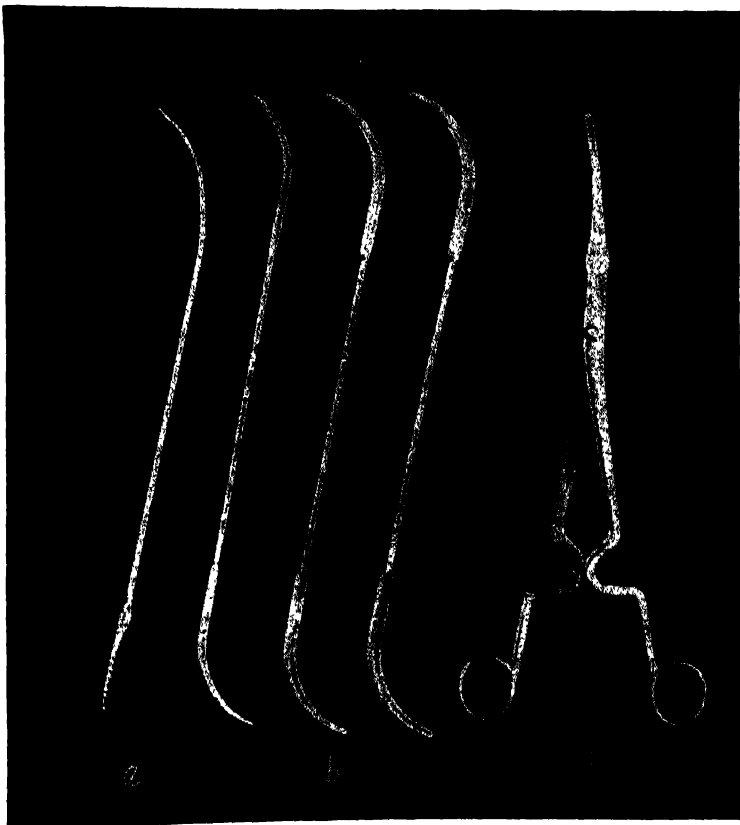
Fig. 279.—Instruments for dilating cervix. a, uterine sound; b, three graduated metal dilators for enlarging the cervical canal; c, small branched dilator.

specimen should be at once dropped into a small bottle of 10 per cent formol or 95 per cent alcohol and sent in a mailing tube to the pathologist for microscopic study. A supposed simple polyp may show beginning malignancy. If the pathologist's report shows no malignancy, the incident is still not closed. What caused the polyp? A cervical polyp usually means chronic irritation inside the canal. This should be eliminated before adenocarcinoma develops in that hidden location. The plan of curettage and conization provides effective treatment for this condition, and at the same time gives adequate material for decisive microscopic investigation.

Exploration of Endometrial Cavity

Invasion of the uterine cavity with sound or curette requires careful asepsis. It carries some risk and should be employed only for some special purpose warranting the risk. The gas test for tube patency and the securing of minute endometrial specimens, for microscopic examination to determine if ovulation has taken place, are taken up later under special examination measures.

Dilatation of the cervical canal as a diagnostic and therapeutic measure for stenosis is not infrequently required. Instruments for office dilatation are shown in Fig. 279. When there is bleeding or discharge indicating some disease of the endometrium, regular curettage in the hospital under operative preparation and asepsis is the advisable diagnostic and therapeutic measure. At the same time under operative analgesia chronic inflammatory tissue may be coned from the cervix and also deep palpation made of the various pelvic structures. This is taken up in detail when considering examination under anesthesia.

RECTOABDOMINAL PALPATION

In many cases it is of decided advantage to follow the vaginoabdominal and speculum examinations with rectoabdominal palpation. This is made primarily for high palpation back of the uterus and peritoneal cul-de-sac and parametrium. It is particularly helpful when there is marked retrodisplacement of the uterus or a mass in the cul-de-sac or parametrial infiltration. In cancer of the cervix, rectal palpation in front of and back of the parametrium on each side will add much information as to the extent of parametrial involvement, for the sweep of the examining finger is not limited as it is when examining within the vaginal vault.

The index finger of the gloved hand, well lubricated, is introduced into the rectum and carefully worked up high back of the uterus and parametrium and between the uterosacral ligaments. Then with the abdominal hand the structures are pressed down for palpation with the rectal finger, as indicated in Fig. 280. The posterior surface of the retrodisplaced uterus may be outlined and also any mass in the cul-de-sac. Fluctuation there may be made out and the presence and extent of parametrial infiltration determined. When seeking the pedicle of a movable tumor, it is sometimes helpful to have an assistant push the tumor upward as shown in Fig. 281.

Incidentally, this rectal palpation will show whether or not there is any marked disturbance in the hemorrhoidal area, and trouble there is sometimes an important factor in the patient's distress. The hemorrhoidal area is usually somewhat tender and there may be sphincter spasm with considerable pain on introduction of the examining finger. This may be lessened by directing the patient to "bear down," thus relaxing the spastic muscle as much as possible. If there is sharp pain, as from a fissure, an application of 10 per cent cocaine solution may be made for the rectal intrapelvic palpation. Of course, if there is definite rectal trouble of undetermined character a regular examination with the rectal speculum is advisable.

Rectovaginoabdominal Palpation.—In exceptional cases when making the rectoabdominal examination, it is advantageous to introduce the thumb into the vagina in order to grasp the lower part of a mass between the finger in the rectum and the thumb in the vaginal canal, the structure being pushed down within reach by the abdominal hand (rectovaginoabdominal palpation, Fig. 282).
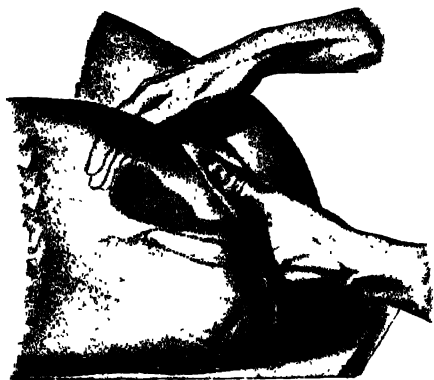
Fig. 280.

Fig. 281.

Fig. 280.—Rectoabdominal palpation. The hand should be gloved. (Montgomery—*Practical Gynecology.*)

Fig. 281.—Palpating the pedicle of a tumor, with the tumor pushed up into the abdominal cavity and the uterus caught with a tenaculum forceps and pulled downward. (Montgomery—*Practical Gynecology.*)

Palpation of Coccyx.—In cases of persistent pelvic pain where no sufficient cause is found about the uterus or adnexa, the coccyx should be palpated. This small bone at the tip of the sacrum is not infrequently the site of neuritis or arthritis or a chronic inflammation resulting from an injury sustained months or years ago. These injuries can usually be traced to childbirth, though occasionally such a condition will result from a fall. In some cases, disturbance may become manifest here without previous injury. Tenderness of the coccyx or a mass about any portion of it, or a deformity, may be easily determined by an examination with the gloved index finger in the rectum and the thumb over the coccyx (Fig. 283). The examination is most conveniently made with the patient lying on her side. In this way the coccyx may be accurately outlined and any deviation from the normal determined. In some cases the coccyx appears to be normal until an attempt is made to move it, when there is severe pain, indicating trouble in the joint or about the fasciae or muscles.

LOCALIZATION OF BACKACHE

Pain in the back is a prominent symptom in many pelvic diseases, and in many extrapelvic diseases as well. Its diagnostic significance depends on its location, that is, upon the structure involved. Consequently, a careful localization of the backache should be made in each case, the same as pain or tenderness in the abdomen is accurately located.

After finishing the intrapelvic examination, have the patient sit up on the table. The clothing is raised from the lower back and the patient is requested to indicate exactly where the backache is or comes at times. Notice whether it is in the lumbar region or over the sacrum or in the coccygeal area. Then palpate firmly with the finger tips over the region indicated and elsewhere, to determine if there is point tenderness or if the trouble is just a diffuse aching. Give particular notice to the sacroiliac joints to see if there is tenderness from arthritis on either side (Fig. 284).
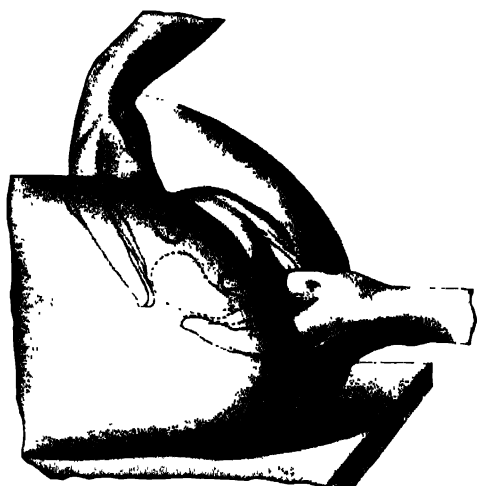
Fig. 282.

Fig. 283.

Fig. 282.—Rectovaginoabdominal palpation. One or two fingers of the gloved hand are introduced into the rectum and the thumb into the vagina, and the uterus, or other mass low in the pelvis, is grasped between them, as it is pushed down by the abdominal hand. (Montgomery—*Practical Gynecology.*)

Fig. 283.—Method of palpating the coccyx. The hand should be gloved. (Hirst—*Diseases of Women.*)

Backache From Genital Diseases

Backache may be caused by any genital lesion which leads to intrapelvic congestion or pulling or pressure. The pain in the back due to intrapelvic disease is usually diffuse across the sacrum. Definite tenderness on palpation is not ordinarily a part of this type of backache, though tender areas due to other conditions may be associated with it.

Though retrodisplacement of the uterus causes backache in some cases it does not do so in all cases or as uniformly as popularly supposed. A considerable proportion of patients with retrodisplacement have no pain in the back. One condition that causes a most persistent and annoying backache is parametritis posterior, and it is frequently overlooked in a pelvic examination.

Another genital lesion that nearly always causes backache is prolapse of the uterus with cystocele and rectocele.

Backache From Extragenital Conditions

Backache from extragenital disease is of very frequent occurrence and must be given due consideration when determining the diagnostic significance of this common symptom. It may be situated in the lumbar region, in the sacral region, or in the coccygeal region.
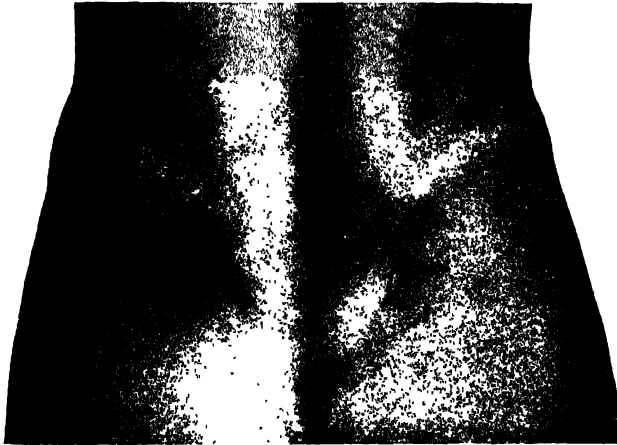
Fig. 284. Areas to be palpated for point tenderness. Area of kidney tenderness shown by "x." Below, area of sacroiliac tenderness and still lower, area of coccygeal tenderness. (Crossen and Crossen— *Synopsis of Gynecology*, The C. V. Mosby Company.)

PREPARATION FOR GYNECOLOGIC EXAMINATION

The various points considered under this head may be grouped as follows:

> Office Arrangements.
> Directions to Patient.
> Protecting Measures.
> Preservation of Specimens.
> Examination at Home.

Office Arrangements

There are three things of particular importance in the handling of gynecologic patients:

1. **Screened Area in the Consulting Room.**--The portion of the room that is used for the examination should be suitably screened from the other part, so that the patient may make such arrangement of the clothing as she wishes in privacy. It is very convenient to have a separate room for the examining room. Where no separate room is available, a neat substantial screen, affording the patient privacy for the required preparation, does very well and is inexpensive.

2. **Table.**--A satisfactory table for gynecologic examinations is the regular surgical chair with footrests. The advantage of the footrests is that the patient's hips may be brought to the end of the table without her feet being forced so near the buttocks as to be uncomfortable.

3. Nurse.—When a physician is doing much gynecologic work, it will be found a wise investment to have a nurse to prepare the patients for examination and to prepare the necessary articles needed in office examination and treatment. Aside from the great convenience to the physician, it makes the patients more at ease, and, in addition, tends to protect the physician from blackmail by designing persons. When a nurse is not required for other work, she may be hired just for office hours.

Directions to Patient

Direct the patient to **loosen all bands** about the waist, so that the clothing may be pushed up and down sufficiently to bare the abdomen. This is necessary at first, for the first examination should be thorough, including examination of the entire abdomen as well as the pelvic exploration. Examination of the breasts may be necessary in cases of suspected pregnancy.

In the subsequent visits, it may not be necessary to loosen the clothing, depending, of course, on what treatment or further examination is required. It is not necessary in ordinary speculum treatments. Any treatment, however, necessitating deep bimanual palpation, such, for example, as replacement of a retrodisplaced uterus, requires the loosening of bands.

Protecting Measures

The measures necessary for protecting the patient and your hands from infection are simple and easily carried out. First, use a paper towel or other protecting material under each patient. Second, employ a rubber glove when palpating the genitals or making internal examinations. Third, drop soiled gloves and instruments immediately into a basin for later sterilization, and thus avoid contaminating the table or washstand or other articles.

After the office work is finished, water is poured into the basin of soiled gloves and they are boiled for ten minutes. It is well to have a towel in the basin to protect the gloves from injury by direct contact with the hot metal bottom and sides. After the sterilization, the gloves are taken out, cleansed in water to remove all foreign particles adhering to them, dried on a clean towel (being turned inside out often enough to secure good drying), dusted inside and out with a drying powder, wrapped in a clean towel, and laid away for subsequent use. When there is an examination or treatment requiring sterile hands, a pair of the rubber gloves is wrapped in a small towel and dropped into the water on top of the instruments, to be boiled with them.

Preservation of Specimens

The preservation of specimens for microscopic examination is a very simple procedure, and yet in many doubtful cases, curettings or cervical polypi removed or pieces of tissue passed spontaneously are thrown away or kept in such a manner that they are not fit for microscopic examination. Thus is lost a valuable aid to early diagnosis, in conditions where early diagnosis is important.

A good all-round preservative for these specimens is alcohol (95 per cent). It is nearly always at hand, and it preserves the specimen indefinitely in good

condition for microscopic examination. As soon as possible after removal, and without unnecessary handling, the specimen is dropped into a small bottle containing the preservative and then forwarded to the pathologist.

A 10 per cent solution of formol is another good preservative. Formol, which is a 40 per cent solution of formaldehyde gas, is known also as formalin and as formaldehyde solution. An advantage of the formol solution over alcohol is that the formol does not interfere with immediate diagnosis by frozen section.

Examination at Home

When a patient is seen at her home, sick in bed, the methods of exploration employed are usually abdominal, vaginal, vaginoabdominal and, in some cases, rectoabdominal. A patient who is too sick to come to the office for a

Fig. 285.—Patient arranged in bed for abdominal examination.

pelvic examination is usually suffering, not with a superficial disturbance that can be seen by inspection of the external genitals or through a speculum, but with some deep-seated trouble, the nature of which can be determined only by deep internal palpation. In most cases of this kind the inspection of the genitals and the speculum examination add nothing of importance to the information otherwise obtained, and may be omitted.

In such a case, the abdominal examination is made first. The patient is directed to move to the edge of the bed and the clothing is loosened and pushed up and down, to expose the abdomen, and the knees are drawn up to relax the abdominal muscles (Fig. 285). The abdomen is then examined by the various methods previously explained.

The vaginal and vaginoabdominal examinations, with deep bimanual palpation, may be conveniently and satisfactorily conducted with but little dis-

Fig. 286.—Patient arranged in bed for vaginal examination.

Fig. 287.—Position of examiner for accurate bimanual examination with the patient in bed, showing the relations of the examining hand and arm. The examiner sits on the side of the bed and the arm lies *between* the widely separated thighs, so that the examination is made from directly in front of the pelvis.

Fig. 288.—Regular "cross-bed" position. The patient is turned directly across the bed, with the hips resting on the edge of the bed and each foot on a chair.
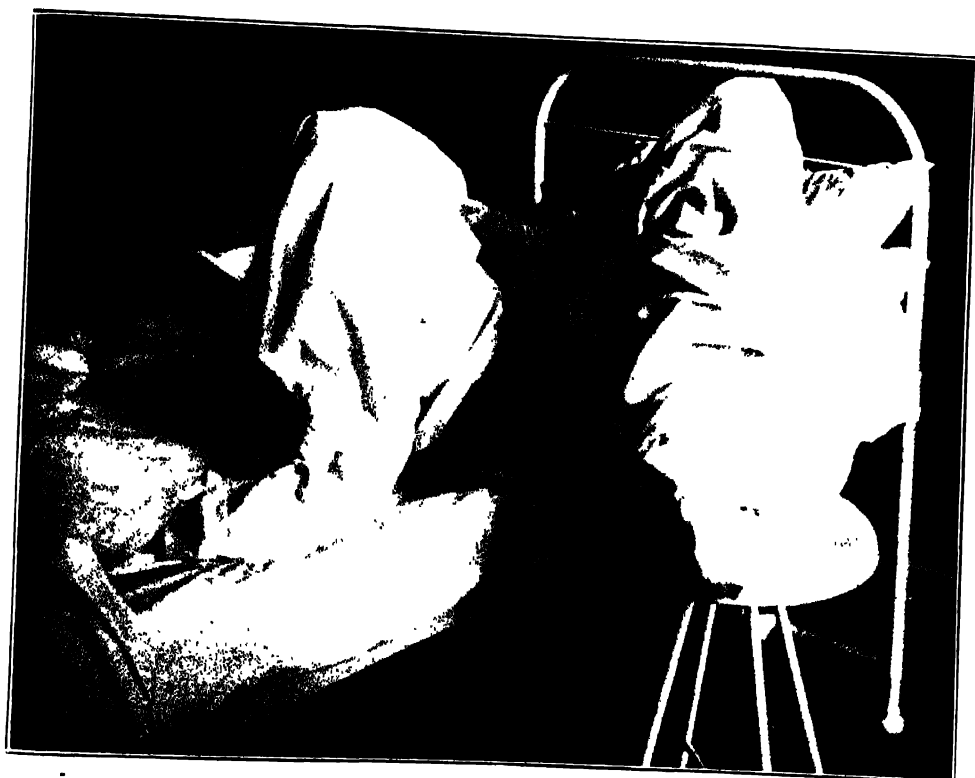
Fig. 289.—Another method of arranging a bed-patient for examination of the external genitals. This is useful when the patient is very sick or when movement is painful. The hips are simply slipped to the edge of the bed and one foot is placed on a chair.

turbance to the patient by observing the following directions, some of which were partially carried out in arranging for the abdominal examination:

1. Direct the patient to move close to the left edge of the bed. There is but little disturbance—she lies just as she is in bed, except nearer the left edge (or the right edge, if the examiner uses the right hand for the internal palpation). A patient seriously sick, even with peritonitis, may usually be moved over sufficiently.

2. Remove the heavy bedclothing, all except the sheet with perhaps a light blanket, and have the patient draw up both knees so that the feet are near the buttocks (Fig. 286).

Fig. 290.   Fig. 291.

Fig. 290.—Kitchen table, with portable foot rests attached ready for a gynecologic examination.
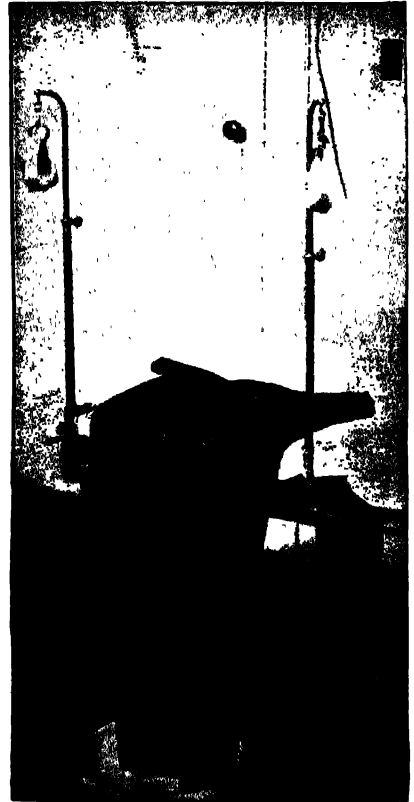
Fig. 291.—Kitchen table arranged with portable leg holders, for curettage or other small vaginal operation, when the patient cannot be taken to the hospital.

3. Sit on the bed, against the patient's left foot, and direct the patient to separate the knees widely. The gloved examining hand (with the index and middle fingers well lubricated) is to be passed **between** the patient's thighs (Fig. 287)—not under one thigh, as ordinarily directed. The examining fingers are introduced deeply into the vagina, care being taken to depress the perineum sufficiently to allow their introduction without pain.

4. After the simple vaginal examination is completed, then the right hand is made to depress the abdominal wall into the pelvis as in the regular bimanual examination.

The authors call special attention to the details given above because they find that their accurate carrying out aids materially in securing needed information in deep-seated pelvic troubles. By following the directions closely, the examining hands and arms are made to occupy practically the same advantageous relation to the pelvis as in the regular office examination with the patient at the end of the table—that is, the examination is made from **directly in front** of the pelvis. The usual procedure of sitting on a chair beside the bed, with the examining arm passed under the thigh (instead of between the thighs) is much less effective when deep pelvic palpation is required.

While the above-mentioned examination methods are generally the only ones required when the patient is sick in bed, there are some cases in which further examination is advisable. Whenever the patient complains of sores about the genitals or of itching or burning or profuse discharge, the genitals should be inspected in a good light. Likewise in any case in which it is thought that additional information of value may be obtained by the speculum examination, that procedure should be carried out.

For the inspection of the external genitals and for the speculum examination, the patient may be turned across the bed with the hips near the edge and each foot resting on a chair (Fig. 288). This is often referred to as the "cross-bed" position. If movement of the patient to this extent is likely to cause pain, she may be simply turned slightly and one foot placed on a chair while the other foot rests on the bed, as shown in Fig. 289.

Where a special gynecologic examination is required at the patient's home, portable footrests may be attached to a plain kitchen table (Fig. 290). With these portable footrests are furnished also tall uprights for use as leg-holders (Fig. 291), by which the feet and legs may be held out of the way during examination under anesthesia or during an operation. They are convenient for use where a minor operation must be done in the patient's home.

SPECIAL EXAMINATIONS

It is not necessary to take space for details of all the examinations required in regard to probable or possible conditions or complications in gynecologic patients. Perusal of the list near the beginning of Physical Examination will direct attention to the possibilities in various directions and the necessity of following them up--either personally or through consultations. The importance of this is emphasized by the growing demonstration that the body functions as a unit in physiological and pathological activities and consequently that the whole must be considered when trying to determine the cause of special action in a part. By keeping this in mind many serious diagnostic mistakes will be avoided, such as the employment of radical gastric and dietetic measures for persistent nausea and vomiting without determining if the patient is pregnant or the employment of pelvic operation for severe pelvic distress that is only a psychic fixation. Space is available here only for those special examination measures particularly related to the genital organs. They are taken up in the following order:

Through the Speculum (colposcopic magnification, chemical [iodine] test, pH of vaginal contents, endometrial specimens, gas test for tube patency).

X-ray Examinations (outlining tubal occlusions, uterine and tubal cavities, fetal bone shadows, calcified portions of tumors, sacroiliac and spinal arthritis, tumor metastasis in bone, prolapsed kidney, intestinal conditions, sella turcica distortion, internal exostosis of skull).

Pelvic Examination under Anesthesia (vagoabdominal, rectabdominal).

Aspiration of Fluid.

Intra-abdominal Inspection (through endoscope, through incision).

Endocrine Investigations.

Pregnancy Tests.
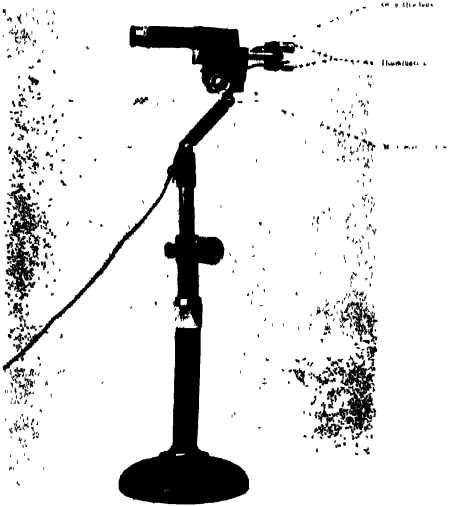
Fig. 292.

Fig 293.

Fig 292.—The colposcope. (Hinselmann in *Gynecology and Obstetrics* by Davis, published by W. F. Prior Co.)
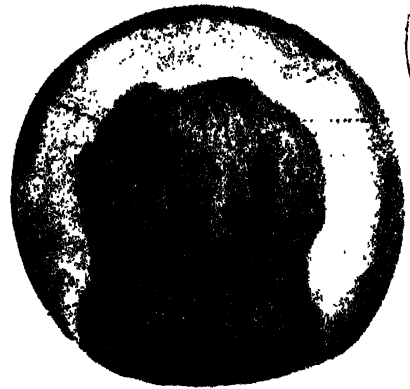
Fig. 293.—View of everted cervix as seen through the colposcope. (Hinselmann in *Gynecology and Obstetrics* by Davis, published by W. F. Prior Co.)
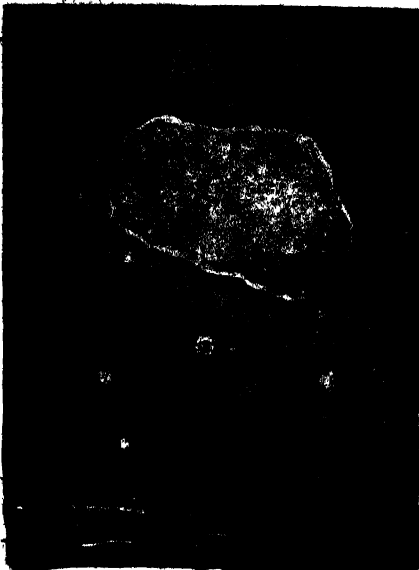
Fig. 294.—Leucoplakia of the cervix. *A.* As it appears through the colposcope; *B,* same cervix as seen through the speculum with the naked eye. (Hinselmann in *Gynecology and Obstetrics* by Davis, published by W. F. Prior Co.)

Colposcopic Magnification

By means of the colposcope a magnified view of areas of the cervical and vaginal surfaces are obtained through a system of magnifying lenses used in connection with the speculum examination. The magnification is five to ten times, and it brings out the minutia of a pathological area in a striking way. Fig. 292 shows one type of colposcope, and the magnification secured is shown in Figs. 293 and 294. Less expensive colposcopic instruments are now made as part of the popular lighted endoscopic diagnostic sets. Such a magnifying lens-tube attached to a speculum is a convenient form.

A.   *B.*

Fig. 295 – Lahm-Schiller test on a normal cervix. *A*, before use; *B*, after iodine solution has been applied. (Henriksen—*Surg., Gynec. and Obst.*)
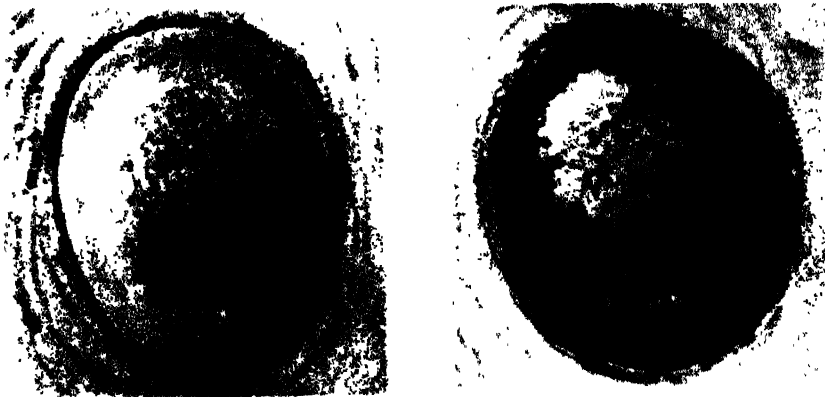
A.   *B.*

Fig. 296.—Lahm-Schiller test on an abnormal cervix. *A*, before use; *B*, after iodine solution has been applied. Note that the areas of eversion and erosion are not stained. (Henriksen—*Surg., Gynec. and Obst.*)

This diagnostic instrument for magnifying early pathologic changes on the surface of the cervix is very helpful in certain lines of investigation, particularly in studying the early changes in cancer and other lesions. It is not necessary, however, to have expensive instruments in order to make the important clinical decisions that must be made in these cases of pathologic cervix. The important thing is to remove promptly any chronically irritated area, while

it is still a simple process. Do not procrastinate by watching such an area, with or without special instruments, for the first sign of cancer. Remove it before the cancer develops.

Chemical (Iodine) Test

The chemical test, called also the Schiller test, depends on the fact that the normal squamous epithelial cells of the vagina contain glycogen and hence stain brown when iodine is applied. The cervix and adjacent mucosa are painted with Gram's iodine solution (iodine 1 part, potassium iodide 2 parts, water 300 parts), which causes the normal squamous epithelium to stain a uniform brown color. Areas of eversion, erosion, cervicitis, cancer, and other pathologic conditions do not stain, and hence become more noticeable by contrast (Figs. 295, 296).

Interesting in this connection is the fact, mentioned in Chapter 1 (Anatomy and Physiology), that this glycogen storage in the vaginal epithelium seems to depend on the sex hormones, and is ordinarily absent in childhood up to puberty and also after the menopause. During the first few days after birth the cells show glycogen storage, presumably due to the sex hormones supplied to the child by the mother.
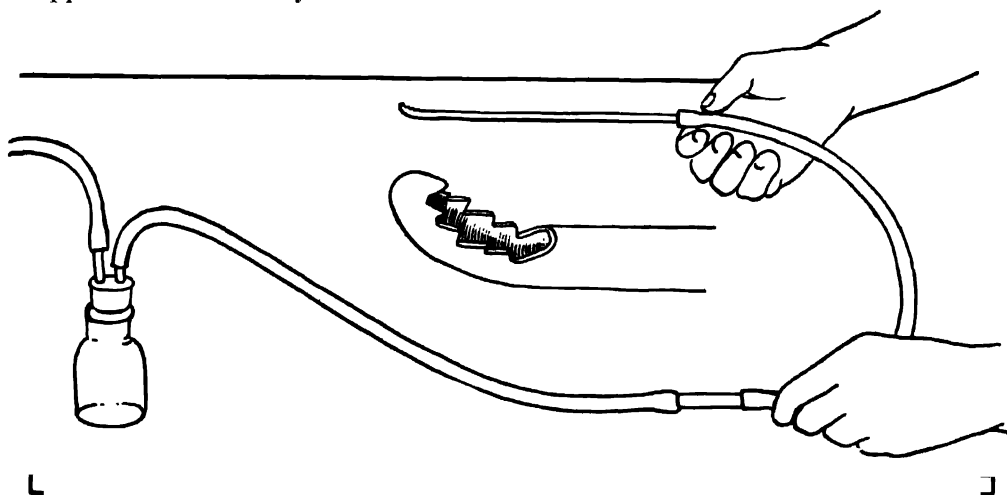
Fig. 297.—Diagram of cannula used by Novak and its connection with the bottle that receives the aspirated curettings. The tube at the left is connected with the motor suction pump. The tubing must be rigid, as a flaccid tube would be collapsed by the strong negative pressure. As particles of tissue may adhere to the walls of the tubing, the latter should be washed by sucking a formaldehyde solution, cold water, or citrate solution through the open end of the cannula into the bottle after the operation. The detail of the serrated fenestrum of the cannula is shown in the insert. At the proximal end of the latter is a flattened disk to indicate the direction of the serrated edge. (Novak—*J. A. M. A.*)

Determination of pH of Vaginal Contents

(Quantitative pH Determinations)

A fairly uniform relation has been demonstrated between the chemical reaction of the vaginal contents and the activity of various forms of pathogenic organisms, as explained when considering vaginal discharge (Fig. 250). Determinations of the pH at different parts of the vagina and at different times are useful, particularly in investigative work. There are different methods of estimating the pH.

Nitrazine Method. The nitrazine test paper, prepared by the Squibb Company, records pH readings from 4.5 to 7.5. The introitus is wiped dry, to remove any secretion from the Bartholin glands. Then before any digital examination the speculum is introduced *dry* without turning it in the vagina. The nitrazine paper can then be placed against the vaginal wall at the posterior fornix, or some secretion can be wiped from that area with a cotton swab and applied to the paper. After a few seconds the color of the paper is compared to the color chart, and the pH is read directly from that chart.

Endometrial Biopsy

The physiological studies given show that the condition of the endometrium is an index as to ovarian activity. By means of minute specimens of the endometrium, secured in the office at certain periods of the menstrual cycle,
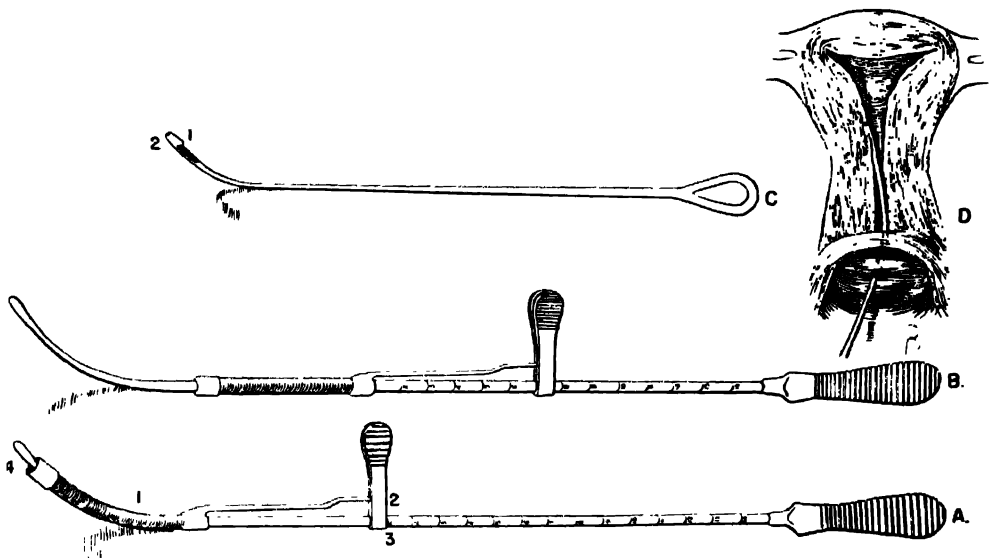
Fig. 298.—*A*, hysterometer. *1*, coiled spring so that curve of sound may be passed; *2*, spring clip which is used as handle to move measuring part of apparatus and to hold it steady on shaft; *3*, area of measurement. Note that it registers 1 cm. and that there is 1 cm. at *4*. *B*, hysterometer measuring cupped curette *1*, sharp overhang to curette; *2*, small hole in cup to allow escape of secretions. *D*, curette removing tissue from endometrium. Curette can be used numerous times to obtain tissue from different regions but a piece from either side is usually sufficient. (Meigs—*Am. J. Obst. & Gynec.*)

information may be gained as to ovulation and also as to the effects of endocrine treatment. Several types of small curettes for this purpose have been devised. Some are used with suction, as Novak's shown in Fig. 297, and some without suction, as that devised by Meigs (Fig. 298). The latter is very small, which reduces the discomfort of the procedure.

With the vaginal speculum in place, a suitable antiseptic is applied to the cervix and the cervical canal; the sterile curette is introduced to the fundus and then drawn gently but firmly along the wall to obtain the endometrial specimen. The specimen is immediately placed in the small bottle of 10 per cent formol.

After the usual laboratory preparation, examination of the specimen shows whether the endometrium is that of an ovulatory or nonovulatory cycle, which

information is important in the diagnosis and treatment of sterility and other functional ovarian and uterine disturbances. Also, the effectiveness of endocrine medication may be checked on by information thus gained. The twenty-fifth day of the cycle is the time usually selected. In the term "endometrial biopsy" used in this connection, the "biopsy" refers to the "examination of tissue from the living" and not to the procedure of obtaining the tissue.

Special endoscopes have been devised from time to time for the purpose of visual exploration of the endometrial cavity. However, the imperfect vision secured because of the difficulty in distending the cavity and the dangers of manipulation within the uterine cavity and the more decisive information furnished by curettage, militate against uteroscopy. Hamant and Durand report success in attempts to distend the cavity with sterile water, using just enough pressure to avoid sending the fluid through the tubes into the peritoneal cavity.
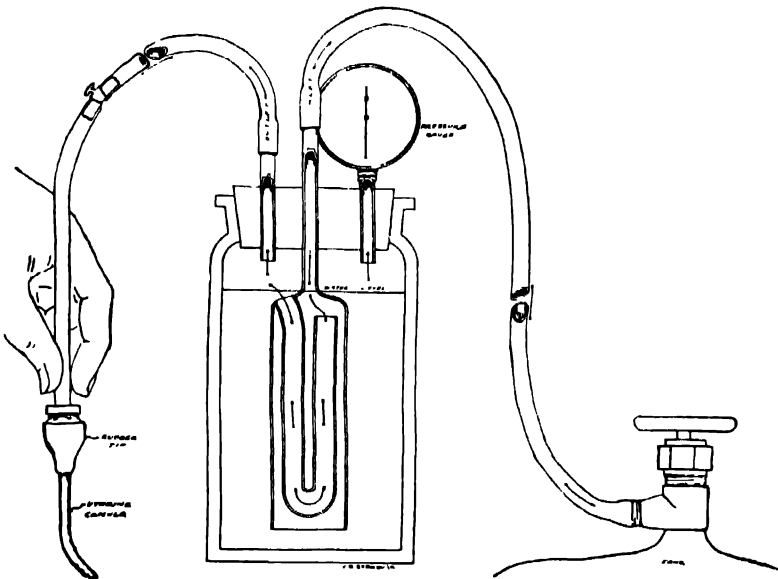
Fig. 299.—Diagram showing the principles of the apparatus for tubal insufflation. The gas flows from the tank through the tubing into the inlet of the pulsating gas meter. The inflowing gas displaces the water in such a way that each pulsation of the meter equals about 40 c.c. of gas. The outflowing gas flows through the rubber tubing leading to the cannula. Between the meter and the cannula is a needle valve conveniently placed for regulating the rate of gas flow. The cannula is equipped with a rubber stopper for the purpose of preventing leakage at the cervical os. The pressure gauge shows the pressure under which the gas is introduced. A mercury manometer may be used for this if desired. (Rubin—*Am. J. Roentgenol*)

Gas Test for Tube Patency

By introducing carbon dioxide into the uterus under measured pressure, the patency or occlusion of the fallopian tubes may be established. This method was introduced by Rubin, who has also done much excellent work in further developing it. If either tube has a normal patency, the gas pressure rises to about 70 mm. Hg, and then falls rapidly to about 40 mm. Hg as the gas passes into the abdominal cavity. Confirmatory evidence that the gas has passed through the tube is the occurrence of shoulder pain when the patient assumes the sitting position. This is a referred pain due to the pressure on the diaphragm, and when characteristic, it is pathognomonic of patency. If the pressure rises to 200 mm. Hg without a fall, this signifies that the gas cannot

pass through, i.e., both tubes are closed. One negative test does not necessarily mean that the tubes are permanently closed, for tubal spasm will sometimes resist the passage of the gas even at fairly high pressure, requiring subsequent tests as mentioned later.

INDICATIONS

1. The test is a step in the systematic examination of a sterility patient. It should not be used until evident causative lesions of the lower genital tract have been eliminated and the husband's fertility has been established by the Huhner test or otherwise.

2. As a therapeutic aid in opening closed tubes. In a total of 2,000 cases of infertility, Rubin reported 205 cases of pregnancy following uterotubal insufflation. Some of these cases were in women over thirty years of age, married five years, who had used no contraceptive measures for a year. Some of these patients became pregnant without other therapeutic measures within
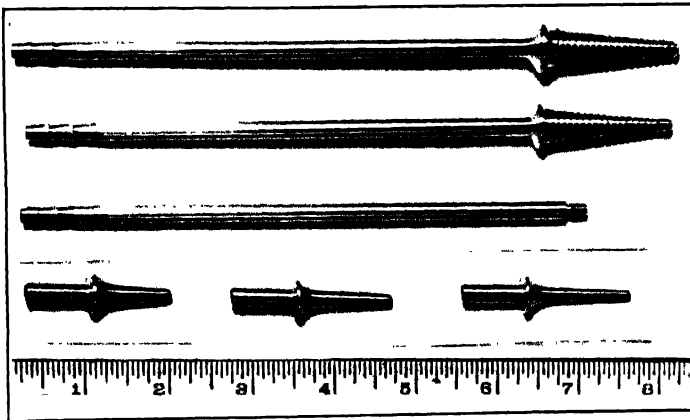
Fig. 300.—Colvin type of cervical applicators for tubal insufflation and uterosalpingography. The screw tips for insertion in the cervix are to obviate the necessity of counter-traction with a tenaculum forceps to prevent leakage. (Colvin—*Am. J. Obst. & Gynec.*)

one month after insufflation. In a review for the period 1920 to 1940, he reported 5,269 insufflations with 32.4 per cent complete obstructions and 33.1 per cent partial obstructions.

3. During laparotomy for closed tubes insufflation from below is an accurate method for proving that patency has been attained.

CONTRAINDICATIONS

1. Bleeding from the uterus or purulent discharge.

2. Recent pelvic inflammation or tenderness.

3. Large pelvic tumors or tumors associated with inflammation.

4. Serious cardiac or respiratory disease or fever.

5. Free bleeding on insertion of cannula (usually means cervicitis, acute or subacute).

6. Pregnancy.

APPARATUS

The apparatus for the introduction of the gas consists of (1) a metal cannula of the Keyes-Ultzman type, with several small perforations near its tip and fitted with a conical rubber stopper, (2) an arrangement for measuring the gas as it passes through water, (3) a manometer for measuring the gas pressure, and (4) the tank containing the gas to be used, i.e., carbon dioxide or oxygen, preferably the former. It is well to have a needle valve, for releasing the gas pressure, at a convenient part of the tube near the uterine cannula. The ordinary apparatus is shown in Fig. 299, and a special screw cannula to prevent leakage from the cervical canal in Fig. 300.
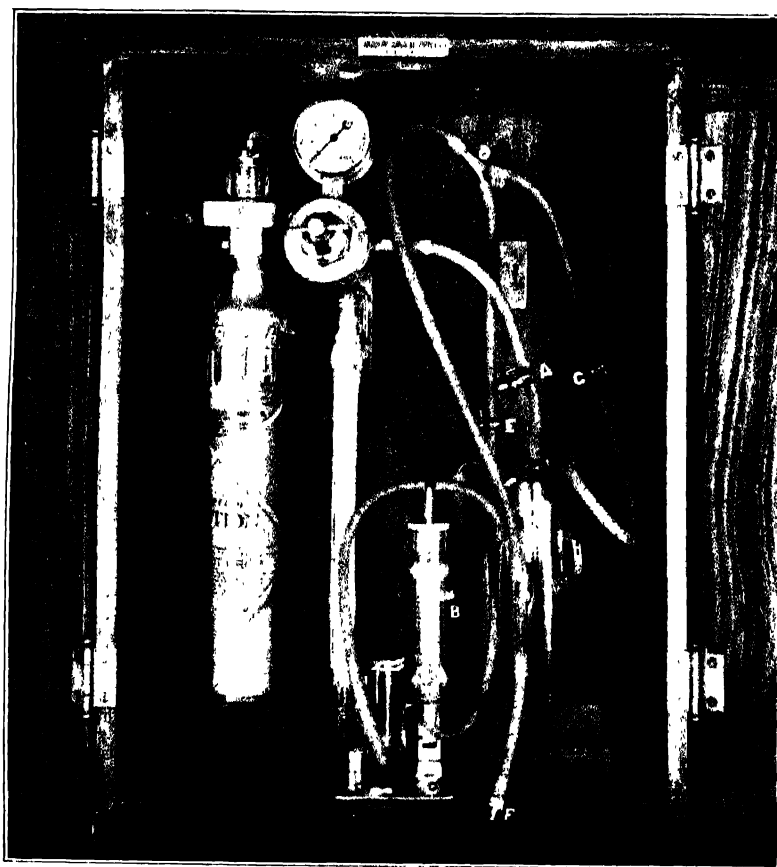
Fig. 301.—Baldwin modification of the Jarcho pressometer for transuterine insufflation, pneumoperitoneum and uterosalpingostomy. (Baldwin—*Am. J. Obst. and Gynec.*)

There are many modifications of apparatus. The one shown in Fig. 301 is a combination which may be used for tubal insufflation, pneumoperitoneum, or lipiodol injection. It is a modified Jarcho apparatus reported by Baldwin.

TECHNIQUE

The best time for the test is from four to seven days after the beginning of menstruation. At this time the endometrium is lowest and is least liable

to infection; there is less chance of blowing bits of endometrium into the abdominal cavity; and the possibility of interfering with an existing pregnancy is eliminated.

1. The apparatus is tested and the necessary instruments and parts are sterilized. The rate of flow is adjusted so that the mercury rises 100 mm. Hg in fifteen seconds.

2. The patient is placed in the dorsal position with hips elevated, a bivalve speculum is inserted, and the cervix is painted with a suitable antiseptic.

3. The uterus is sounded to ascertain the direction of the canal and to be sure that there is no stenosis of the internal os. If there is some stenosis, dilatation is done with a uterine dressing forceps.

4. The anterior lip of the cervix is then grasped with a two-toothed tenaculum and the modified Keyes-Ultzman cannula is inserted into the uterine canal so that the point is well above the internal os and the rubber stopper fits snugly into the external os.

5. The needle valve is opened and the gas allowed to flow into the uterine cavity while the operator watches the pressure on the manometer. During this time the rubber stopper must be kept tightly pressed against the cervix to prevent leakage of gas. If there is any leakage, it can usually be heard.

6. The pressure should be watched carefully and not allowed to rise above 200 mm Hg. Four pulsations of the siphon meter, or 160 c.c. of gas, are all that is required to show patency. Two or three pulsations, or from 80 to 120 c.c., will suffice in thin individuals.

7. After the test has been completed, the gas is turned off, and the cannula withdrawn. Replace the uterus in the anterior position. If there is any oozing after withdrawing the cannula, a dry vaginal tampon may be inserted.

8. Have the patient sit up, and ask her if she notices any pain. If the shoulder pain is very troublesome, have her assume knee-chest position for five minutes. The gas is usually partially absorbed in this time and the pain disappears.

9. In doubtful cases where the shoulder pain is not characteristic, an x-ray plate may be necessary to demonstrate the pneumoperitoneum. This happens occasionally in stout patients.

INTERPRETATION

The decision as to whether the gas has passed through the tubes is based on two factors: the manometer reading and the patient's symptoms. With the normal patent tube there is an initial rise to 70-100 mm. Hg, followed by a fall in pressure or an absence of further rise when the gas begins to go through the tubes. After patency has been established by the manometer reading, check this by having the patient sit up and inquire if she has any pain. If the gas has passed through the tubes, the patient will usually notice some pain in the shoulder or clavicle area.

When the tubes are permanently closed, the pressure will rise to 200 mm. Hg without a fall. This pressure should not be exceeded except in rare cases and by one thoroughly familiar with the dangers entailed. If the gas passes through at a pressure between 100 and 200 mm. Hg, the tubes are patent; but there is a partial block, either structural or spasmodic.

Some idea as to the position of the block is gained by having the patient locate the pain. With patent tubes there is only a sense of discomfort felt above the symphysis. When the tubes are closed at the uterine end, there is definite, rather dull pain over the uterus during the test, which disappears rapidly on release of the pressure. Sharp pain well out from the median line on both sides, in some cases radiating down the legs, means the block is at the fimbriated ends of the tubes. Unilateral pain with patency established by drop in pressure usually means the blocked tube on the side of the pain. With the block located between the isthmus and the fimbriated end, the pain is felt just lateral to the uterus.

The injection of air or gas with a syringe without measuring pressure and rate of gas flow is not advisable, though it has been recommended by some and instruments have been devised for it. The necessity of knowing the exact pressure and rate of flow for interpretation of conditions has been emphasized by Rubin who insists upon "a slow and careful introduction of the gas rather than an irregular, uncertain and haphazard insufflation." He now uses a ky-
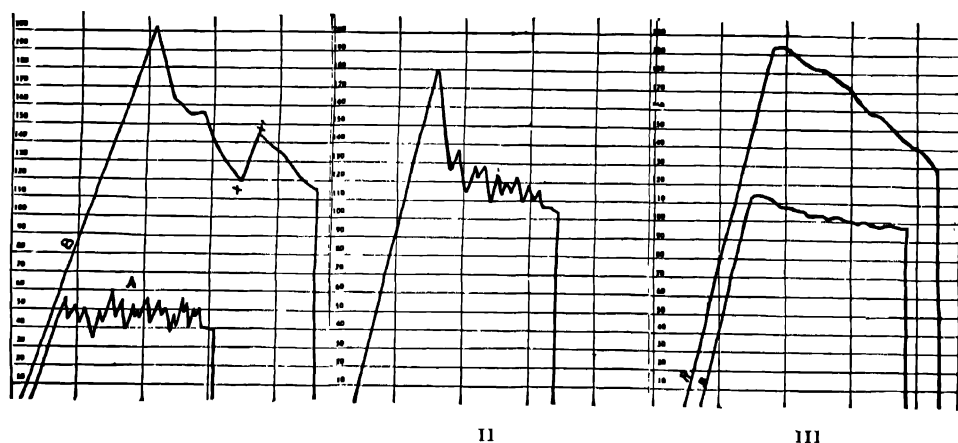
Fig. 302.--Kymograph tracings showing variations in pressure from different causes   I. (A) Tracing of a normally patent tube.   (B) Tracing in a case of stricture of the tube with slight patency. X-X' shows rise in pressure when patient was instructed to bear down.

II. Shows a relatively high pressure before the initial drop, when practically normal peristaltic waves are registered on the kymograph.

III. (A) High grade stenosis in a tube probably patent but probably bound down by light adhesions which inhibit normal peristalsis.   (B) Less marked stenosis, no definite peristaltic fluctuations visible in the tracing. (Rubin—Radiology.)

mograph with the apparatus in order to record variations in pressure on a smoked drum. This records the peristaltic waves, and is especially helpful in differentiating tubal spasm from structural stenosis (see Fig. 302).

Before making a diagnosis of complete obstruction, it is well to make several tests and to precede one of them with a course of medication to relax the tubal sphincters, for example, 75 mg. of trasentin three times daily for five days.

DANGERS

The unfortunate results occurring after gas injection are rare compared with those reported after oil injection, but they do occur. Mansfield and Dudits reported a fatal case of air embolism from a Rubin test done in a patient with unrecognized tuberculosis of the endometrium. We had a case of severe pelvic

infection after a Rubin test in a patient with a partial stricture of the tubes from an old inflammation, probably from an undiagnosed brucellosis infection which later flared up.

Visualization of Uterine and Tubal Cavities

Since the introduction of lipiodol by Sicard and Forestier in 1922, hysterosalpingograms have been added as important aids in gynecologic diagnosis. The use of oily solutions has been largely discarded in later years because of undesirable complications, such as accidental injection of vessels into which the oil penetrated, embolism, nonabsorption of oil from peritoneal cavity and apparent irritation, and acute peritonitis and abscess formation. These dangers have been overcome by the use of water solutions, such as diodrast, skiodan, uroselectans, and in our hands the water medium has been adequate and harmless. Titus suggested the use of acacia with skiodan solution because the combination remains in the uterus and tubes thirty to fifty minutes longer than skiodan alone, and still has none of the disadvantages of an oily solution.
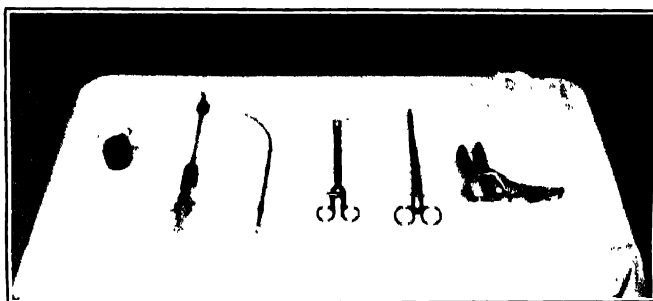
Fig. 303.—Visualization with iodized oil. The articles needed in the technique of the oil injection are here shown. They are, reading from the left, the opaque oil in a sterile medicine glass, the injecting syringe, a uterine sound for testing the direction of the canal and the size of the cavity, a uterine tenaculum forceps for holding the cervix, a uterine dressing forceps, a bivalve speculum, and sterile cotton balls. (Newell—*Am J. Obst. and Gynec.*)

Though improved solutions have superseded the original lipiodol, the procedure is still conveniently referred to as the "lipiodol test" or "lipiodol injection," meaning visualization of the cavities by injection of any of the numerous solutions.

INDICATIONS

1. To localize the point of tubal obstruction in a patient who has previously been shown to have closed tubes by the gas test for patency.

2. In doubtful and obscure cases it is used to show the location of the uterus and tubes in relation to other masses present.

3. It is helpful in the diagnosis and demonstration of congenital abnormalities of the uterus and tubes.

4. Reports of pregnancy following the test in some cases of long-standing sterility indicate that it may have some therapeutic value.

CONTRAINDICATIONS

The contraindications to hysterosalpingography are the same as for the Rubin test, and it should be done only after the Rubin test has shown obstruction in the tubes.

APPARATUS

The apparatus needed for the test is shown in Fig. 303. A specially arranged hand bulb and manometer, suggested by Rubin, are shown in Fig. 304. This addition gives accurate knowledge of the pressure used during injection and enables one to avoid the danger of exerting excessive pressure when the tubes are closed. Jacoby uses the apparatus shown in Fig. 305. A short-tipped cannula should be employed so that the cervical and lower uterine canal can be visualized and submucous myomas diagnosed.
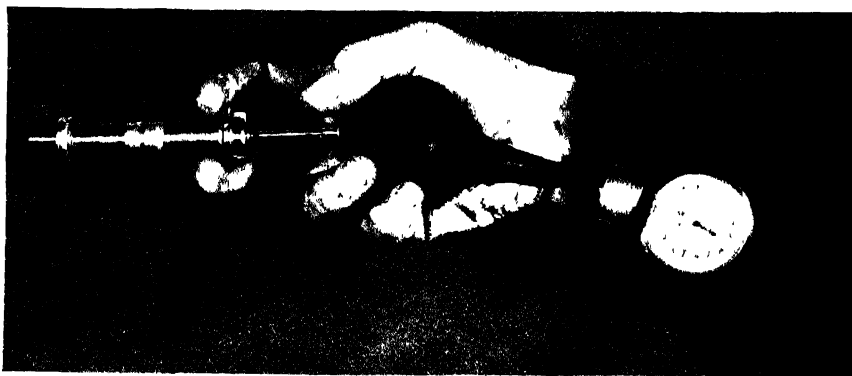
Fig. 304.—A simple method of measuring the pressure under which lipiodol is introduced into the uterus. Pressure is made against the plunger of the syringe with an ear bulb attached to a Tycos manometer.   (Rubin—*Radiology*.)
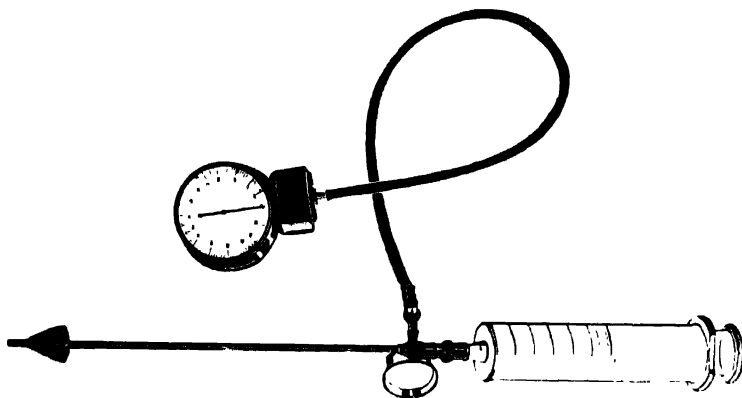
Fig. 305.—Jacoby instrument for tubal insufflation and uterosalpingography.   (Jacoby—*Am. J. Obst. & Gynec.*)

TECHNIQUE

The technique of injection is as follows: The cervix and vagina are washed with green soap and an antiseptic is applied to the cervix and cervical canal. A short-tipped cannula adapted for use on a 10 c.c. syringe is employed. Ten cubic centimeters of the contrast medium are drawn into the syringe and the cannula is fitted on to it. The cervix is then grasped with a tenaculum forceps and, with the rubber cork tight against the cervix, the solution is slowly injected.

The injection is under controlled pressure, so as to avoid rupture of a tube. The simplest method is to press on the plunger with the rubber bulb attached to the sphygmometer, as in Fig. 304. A simple system is shown in Fig. 305.

The exposure is made as soon as the solution has been injected. The cannula is then withdrawn. Hyams suggested taking films after successive injections of 2 c.c. He finds that the patient has less pain with this method, and it also helps to localize the filling-defects from myomas.

INTERPRETATION

In the interpretation of the x-rays it must be kept in mind that the tube cavity does not fill completely, or at least does not become distended, if the outer end is normally open. When the solution reaches the fimbriated extremity, it leaks into the peritoneal cavity; this leakage demonstrates the patency of the tube. The quantity injected should be adequate to cause sufficient leakage for x-ray demonstration but not enough to obscure the picture. If the tubes are closed, the solution fills the tubal cavity proximal to the point of block. The portion of the tube proximal to the block is usually distended, giving a clear-cut, blunt, rounded outline.

If the block is in the isthmus, there is no filling of the tube distal to the uterus. If there is doubt as to whether the solution has escaped into the peritoneal cavity, a simple x-ray taken from three to four hours later will show the mottled distribution of the solution throughout the pelvis. Small constrictions at the cornua of the uterus denote the sphincter muscles located at these points. The lipiodol remains in the pelvis from two to three months and may lead to errors later in x-ray examination for other conditions. Salpingograms and uterograms are shown in Figs. 306 to 309.

DANGERS

As the use of iodized oil increased, the reports on undesirable results likewise increased. There have been at least eleven cases reported in which the oil accidentally entered the pelvic veins, and there are probably many more that have not been recorded in the literature. In an unreported case of ours, the patient experienced a chill and became faint during the injection, but within an hour she felt well enough to go home. The following day her sclera and skin turned a pale yellow and her temperature rose to 103° F., and she had a chill. Because the patient had had frequent attacks of malaria a blood smear was searched for parasites, but none was found. The patient was merely observed and kept at rest in bed until the temperature returned to normal. There has been no subsequent disturbance. In another uterotubal visualization for this patient, made one year later, a watery, opaque solution (neo-iopax) was used instead of iodized oil and there was no leakage into the veins.

Sicard and Forestier deliberately injected iodized oil intravenously first in animals, then into human beings, to see what the effects were. They state that the injection caused no symptoms. In a case reported by Meaker there were no adverse symptoms. Coventry's patient had a chilly feeling, was nauseated, had a rapid respiration and, as she expressed it, was "knocked out" for about thirty minutes.

The frequency of occurrence of this accident led Neustaedter and his associates to recommend a pyridine derivative called "neo-iopax" (uroselectan

B) as the solution for injection. This is similar to the skiodan and is used intravenously in kidney disorders to outline the kidney pelvis and the ureters.

Although some workers in this country and abroad have used lipiodol therapeutically in acute and subacute cases of salpingitis, this certainly is not a measure to be recommended. The importance of excluding such cases when

Fig. 306.—Visualization with iodized oil. This case also presents normal tubes and a more nearly normal uterine cavity. There is a quantity of escaped fluid at the outer end of each tube, sufficient to give a clear demonstration. Gyn. Service. (Newell—*Am. J. Obst. and Gynec.*)

Fig. 307.—Visualization with iodized oil. In this case the right tube was open, as demonstrated by escaped fluid. The left tube was closed at the outer end, as demonstrated by the distention of the ampullar cavity. These findings were confirmed at operation. When the sealed tube was incised, the dark fluid escaped. A portion of the fluid ran out of the uterine cavity before the picture was taken, hence the upper part of the cavity does not show. Gyn. Service. (Newell—*Am. J. Obst and Gynec.*)

Fig. 308.—Visualization with iodized oil. In this patient the plate shows that each tube is occluded in its uterine portion, thus demonstrating at once the uselessness of operation for opening the tubes in this case. Gyn. Service. (Newell—*Am. J. Obst. and Gynec.*)

lipiodol is to be used has been mentioned under Contraindications. One patient in the Gynecological Service of Barnes Hospital developed an acute peritonitis following the test. As the peritonitis continued to spread upward, the abdomen was opened, the old pelvic lesion removed, and free drainage established. The patient recovered after a stormy course.

Rubin reports large pelvic abscesses requiring drainage in two patients and symptoms of peritoneal irritation (cramps, nausea, and vomiting) in three others in a series of 66 injections. J. C. Hirst reports a death from streptococcic peritonitis in which operation for closed tubes was done twenty-four hours after the test.

These facts emphasize the importance of a careful elimination of contra-indications before using the test, and warn against its use where the simpler gas test will suffice, as in determining tubal patency. In a case in which the gas test shows tubal occlusion, the lipiodol injection is indicated to show the

Fig. 309.—Visualization with iodized oil. This is a plate from the case mentioned in the text in which the patient introduced a bent hatpin to produce an abortion. Notice that the uterine cavity is normal, showing no pregnancy. The tubes appear normal, each being open throughout, as demonstrated by the escaped fluid from each. The wound-canal through the uterine wall, made by the thrusts of the large pin, is well visualized by the opaque fluid. The injection of the iodized oil demonstrated clearly that the long pin was entirely outside the uterine cavity. Gyn. Service. (Newell—*Am. J. Obst. and Gynec.*)

location of the occlusion. The importance of this localization, upon which largely turns the possibility or advisability of operation for relief, is sufficient to justify the additional risk.

The improvements in contrast material used, particularly the change from oil to water solutions, have eliminated most of the dangers from the solution, but not all. An allergic death has been reported by Dolan in the use of diodrast for intravenous urography, and he states: "We now test patients who give any past history of allergy. The patient holds 1 to 2 c.c. of the solution in the mouth

for ten minutes, and if there is no reaction the solution is then swallowed. There is then a wait of thirty minutes, and if no reaction the intravenous use is then proceeded with.'' In one case the mouth test gave a prompt reaction. In three minutes there was a sensation of numbness which began in the mouth and spread rapidly over the entire face. The patient expectorated the solution immediately and ephredine was given, but the reaction lasted five hours. The fact that there is always the possibility of the solution getting into the veins makes still stronger the advisability of testing any allergic patient before hysterosalpingography.

To Show Fetal Bone Shadows

After the fetal bones have formed, the bone shadows as shown by x-ray examination may be used as an aid in differential diagnosis in obscure cases. The question as to how early in gestation an x-ray diagnosis of pregnancy may be made from the bone shadows has been reviewed in an instructive article by Bartholomew, Sale and Colloway. Positive bone-shadow x-ray evidences of pregnancy do not appear until four and a half to five months after conception. Keeping this limitation in mind, ordinary x-ray examination may be helpful in differential diagnosis.

A large mass may be a pregnant uterus or a uterine tumor (soft myoma) or an adnexal mass from which the uterus cannot be differentiated. The questions here would be, first, whether or not a pregnancy is present, and if so then, second, whether or not it is in the uterus. If only irregular bone shadows appear, it must be kept in mind that they may be due to a pregnancy too early to show the characteristic systematically arranged shadows, or to an ovarian dermoid, or to calcified areas in a uterine myoma.

Visualization of Arthritis or Stone or Prolapsed Kidney or Tumor Metastasis in Bone

Troublesome pain in the back increased by motion should always arouse suspicion of arthritis of sacroiliac joints or of lumbar spine. If there is definite point-tenderness over these structures with a tendency to arthritis elsewhere and no intrapelvic lesion that should cause the backache, the suspicion is confirmed. In cases in which the diagnosis is doubtful, because lacking definite tender areas in the back or because of a pelvic lesion that may or may not cause the backache, x-ray pictures of the lower spine and pelvis will give helpful information as to joint and bone conditions.

In complicated pelvic conditions in which it is important to rule out stone in the bladder or ureter or kidney or prolapsed kidney or tumor metastasis in bone, a plain x-ray film of the area may be helpful.

Gastrointestinal X-Ray for Appendix, etc.

The close proximity of the appendix and cecum on the right and of the sigmoid at the left and center necessitates those structures being taken into consideration in obscure or complicated pelvic conditions. Consequently x-ray visualization of those structures is frequently required for a differential diagnosis in such cases. Its systematic use in suitable cases would avoid those

tragic surprises in which the abdomen is opened for supposed tubal or ovarian or uterine mass which proves to be tuberculosis of the cecum or cancer of the cecum or colon. The possibility of appendicitis or diverticulitis also must be considered in planning treatment for a persistent mass of doubtful origin. Especially in aged patients with central or left-sided inflammation it is important to rule out diverticulitis. Of course the inflamed and occluded diverticulum does not show in the x-ray, but the probability of this condition is indicated if diverticulosis is shown in a patient presenting no other cause for the inflammatory mass. When desiring to rule out diverticulitis, make particular mention of this to the roentgenologist so that he will take a late plate for residue retained in the diverticuli after elimination of the barium from the intestinal lumen.
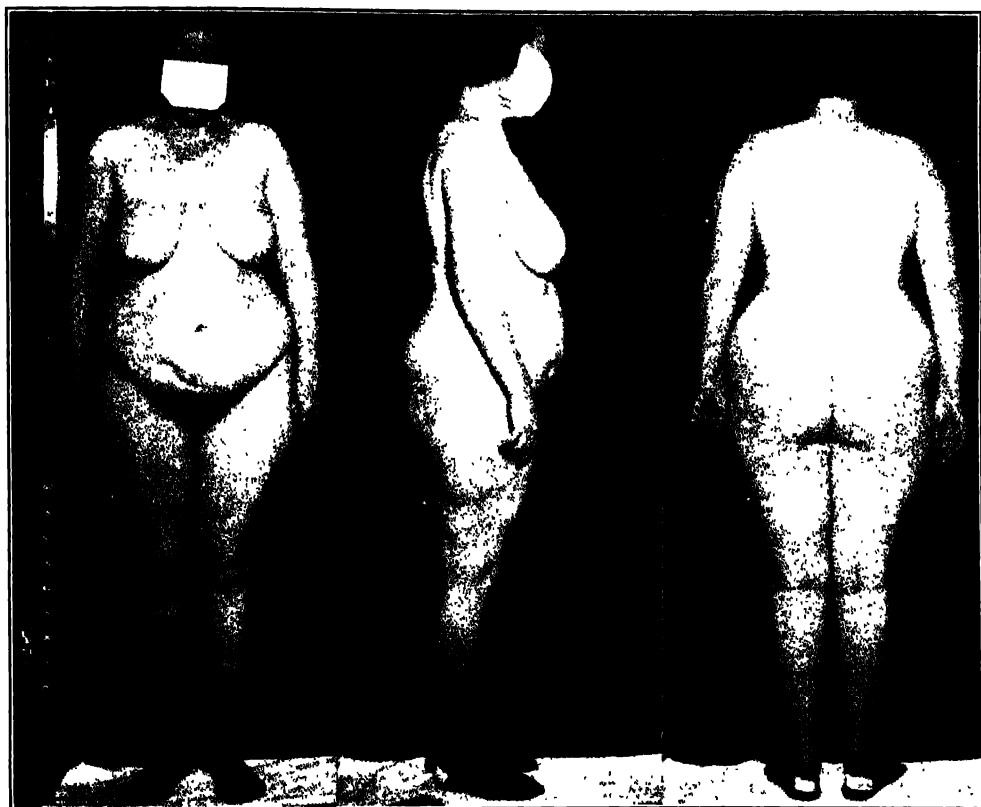
Fig. 310.—Patient with condition shown in Fig. 311. The exostoses are in the frontal area and hence gave no localizing symptoms. This patient was thirty-one years old and suffered from generalized headaches associated with epileptiform-like seizures, dizziness, general fatigue. Menses normal. Negative Wassermann reaction.
    The distribution of the fat extending about halfway down the arms and thighs (indicated by the small arrows) is considered typical by Dr. Moore. (*Am. J. Roentgenol.*)

X-Ray of the Skull

In certain gynecological patients x-ray of the skull is necessary to give required information, for example, in endocrine disturbance possibly due to pituitary tumor or in menstrual headaches that may be a symptom of exostosis affecting the inner table of the skull.

Sella Turcica Distortion.—The functional disturbances of the pituitary gland are sometimes associated with organic changes of sufficient extent to

modify the surrounding bony structures, so that such modification shows in x-ray pictures of that region of the skull. Consequently, in persistent endocrine trouble it is advisable to make x-ray examination of the pituitary region, particularly if the patient presents a pituitary type of obesity or other special indication of pituitary disorder. The reliability of the findings and conclusions depends, of course, on careful roentgenization and experienced interpretation.

Internal Exostosis.— In a patient inclined to headache, the menstrual period is often the favorite time for the most troublesome manifestation, as it is for many other disturbances of the nervous system. There is not space for a general differentiation of menstrual headaches, but it seems advisable to call attention to one troublesome type which has recently been elucidated, with considerable relief to the patients so afflicted.

This is characterized by exostoses on the inner table of the skull in the frontal region, with resulting pressure on the so-called "silent area" of the brain. The condition is of interest to gynecologists in that it is the cause of one of the severe types of menstrual headache (often with visual disturbances) and not infrequently there are other menstrual disturbances, such as exces-
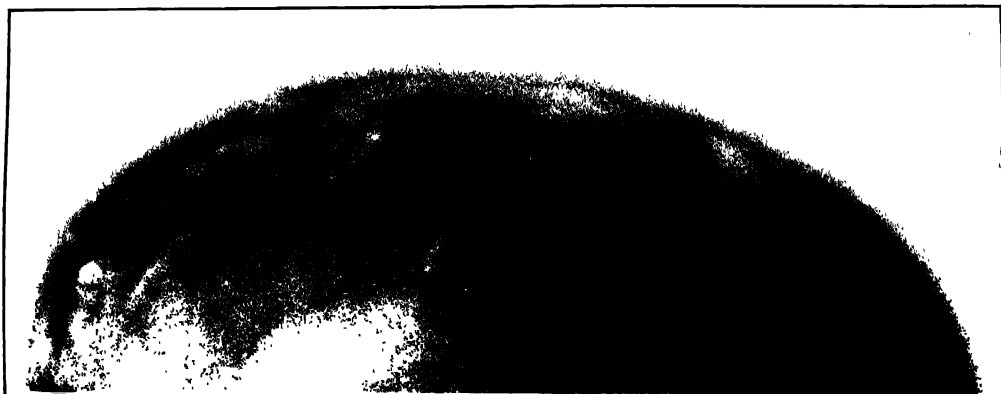
Fig 311.—Exostoses frontalis interna. This condition, described by Dr. Sherwood Moore, consists of exostoses on the inner table of the skull. In this roentgenogram the exostoses are seen at the left edge of the figure on the inner table in the frontal area. This is the skull plate of the patient shown in Fig 310   (Moore—*Am. J. Roentgenol.*)

sive flow or amenorrhea. Another point of interest is that the pelvic and other symptoms closely resemble those ordinarily associated with certain cases of pituitary dysfunction, and this diagnosis is very likely to be made.

The details of this condition were worked out by Sherwood Moore, professor of Radiology, Washington University School of Medicine. He investigated very extensively these inner-table exostoses, the resulting clinical symptoms and associated bodily changes, and has called attention to their importance in the articles given in the Reference List.

The symptoms listed by Moore as characteristic of this condition are: 1. Headaches, often disabling. Cranial tenderness with sometimes a feeling of pressure. 2. The obesity may be extreme and is of the rhizomelic type. 3. Visual disturbances of various types. 4. Easy fatigue and muscular weakness. 5. The breasts are usually larger and more pendulous than they are in women who do not have hyperostosis of the skull. 6. Hair growth on the chin is common. 7. Mental dullness, dizziness, depression, and poor memory. 8. Epileptiform-

like seizures. 9. Cranial nerve disturbances. 10. Regional sensory and motor disturbances, tingling, numbness, transitory hemiplegias and hemiparesis.

One of the clinical features of diagnostic importance is the fat distribution just to the middle of the upper arm and to the middle of the thigh. This is shown in Fig. 310 which is a photographic study from Dr. Moore's collection. Fig. 311 shows an x-ray of the frontal area of the skull in the same patient. The sella turcica was normal.

We recall particularly two patients with this disorder. One suffered with severe headaches at each period, and also had dizziness, vomiting, partial loss of vision in one eye, and occasionally had convulsive seizures. The other came to us because of daily vaginal bleeding extending over a period of two years. On first examination she seemed to be a typical pituitary case with the usual obesity, bitemporal and frontal headache, and dizziness. Curettings showed a hyperplastic endometrium of the "Swiss cheese" type. The Aschheim-Zondek test gave a Type I reaction. The basal metabolic rate was minus 6. A stereo x-ray of the skull showed a normal sella turcica but an early hyperostosis frontalis interna.

The first patient mentioned above was under treatment by Dr. Carr, of the Department of Neurology, for some months, and had complete recession of troublesome symptoms on a diet high in gelatin

Pelvic Examination Under Anesthesia

The advantage of anesthesia is that it eliminates PAIN and MUSCULAR TEN-SION, the two factors that make the ordinary pelvic examination incomplete and unsatisfactory in certain cases.

Preparations

In preparation for this examination the patient's bowels should be moved with a purgative on the previous day and the rectum should be cleared out with an enema some hours before the examination. The same preparatory examination of the heart, lungs, and urine should be made as though anesthesia were for an operation. Have ready a light, strong tenaculum forceps, so that the cervix may be caught and the uterus pulled down as desired. If the interior of the uterus is to be explored, the antiseptic preparation for curettage must be carried out and the instruments prepared.

Examination Methods

The principal manipulations employed in examination under anesthesia are as follows:

1. Bimanual palpation of pelvic interior.
   Vaginoabdominal palpation.
   Rectoabdominal palpation.
2. Uterine investigation.
   Curettage.
   Conization of cervix for specimens.

Vaginoabdominal Palpation

In vaginoabdominal palpation under anesthesia, the same manipulations are employed and the same facts concerning normal and abnormal pelvic structures are sought as in the ordinary vaginoabdominal (bimanual) examination. Under anesthesia, however, the examination is much more thorough, as deep palpation may usually be made in all portions of the pelvis.

In the examination under anesthesia, the manipulations must always be made carefully and gently, otherwise a collection of pus may be broken open internally, causing peritonitis, or the sac of a tubal pregnancy may be ruptured, causing hemorrhage.

Rectoabdominal Palpation

The rectoabdominal palpation under anesthesia is made for the same purpose as the vaginoabdominal palpation and in the same way except that a finger of the gloved hand is introduced into the rectum instead of into the vagina.

Much additional information may in this way be obtained in some cases because, under anesthesia, the finger can pass farther up the posterior surface of the uterus. By catching the cervix with a tenaculum forceps and pulling the uterus downward, the posterior surface of the uterus and the ovaries and the broad ligaments may be palpated with but little intervening tissue.

Curettage

Curettage for diagnostic purposes is carried out the same as regular curettage for therapeutic purposes. Tissue is thus obtained from all portions of the endometrium for microscopic examination. Consequently, if in the subsequent microscopic examination no malignant tissue is found, we may be fairly certain that there is no malignant disease. Furthermore, regular curettage under anesthesia combines with its diagnostic value a decided therapeutic effect, for it removes the diseased endometrium and diminishes bleeding and discharge. As will appear later, curettage is often indicated in a particular case by both therapeutic and diagnostic considerations.

If there should be any suspicion of carcinoma high in the cervical canal, curette that part of the canal and put the curettings in a separate bottle. The lower part of the cervical canal is included in conization specimens.

Collecting Curettings

In a diagnostic curettage, observe the following points, which assist the pathologist in his work:

1. Put citrate solution (2 per cent sodium citrate) in the vagina, so that it will be carried into the uterine cavity with the curette. Keep adding more citrate solution to prevent clotting on the specimens.

2. Remove the endometrium from all parts of the uterine cavity, so that no small area of carcinoma could be missed.

3. Put all the curettings directly into a basin containing citrate solution. It is preferable to wash them out of the vagina with the citrate solution, so as to avoid handling.

4. Pour the solution containing the fragments through gauze, and then transfer all the tissue fragments, without compression, to a small bottle containing 10 per cent formol, and send to the laboratory. If no formol is at hand, 95 per cent alcohol may be used.

5. If the pathologist is in a distant city, the little bottle should be corked securely and put in a mailing tube or wrapped with cotton and otherwise packed securely for safe transmission.

6. With the specimen, send a note stating the nature of the specimen (curettings from within uterus), when obtained, name and age of patient and some of the important facts in the history of the case. Always give the date of the last menstruation, as the phase of the menstrual cycle at which the specimen is removed has an important bearing on the differential diagnosis in many cases.

Conization of Cervix for Specimens

This excision of all the cervicitis area of the cervix as a therapeutic and diagnostic measure is carried out as described in detail under Chronic Cervicitis in Chapter VII. Its advantages over the old obsolete method of clipping out a small specimen have already been explained in this chapter under Securing Adequate Cervix Specimen.

The cervicitis area may be excised by conization with the electric cutting wire or by conical excision with the knife. The former is preferable where the proper current machine is available, for the latter entails more bleeding and extensive suturing.

Aspiration of Fluid

Ascites. Ascitic fluid obtained by paracentesis may give information as to a causative or associated pelvic growth. All the fluid should be centrifuged and the residue blocked and cut and stained. Tumor cells thus discovered may aid materially in diagnosis.

Pelvic Mass. Occasionally it is advisable to aspirate fluid from a mass in the cul-de-sac, to see whether it contains blood or pus or clear fluid. But before doing so, the points for and against aspiration should be carefully considered, that there be no undue risk in obtaining information that might be better obtained some other way. Exceptionally, an adherent loop of bowel, distended with feces or tense from gas, will give the impression of a cyst or other abnormal mass.

Intra-Abdominal Inspection

When the ordinary methods of pelvic examination fail to furnish sufficient information for a diagnosis which is urgent, intra-abdominal inspection is to be considered. Such inspection may be accomplished through a puncture of the abdominal wall and the use of a specially designed endoscope or through the regular laparotomy incision.

Through Endoscope (Peritoneoscope).—Much work has been done in developing a practical instrument and technique for peritoneoscopy. Ruddock has given an excellent presentation of the subject, and the illustration is from his article. Fig. 312 indicates its pelvic application in combination with movement of the organs by fingers in the vagina. Peritoneoscopy seems par-

ticularly useful in upper abdominal conditions where satisfactory internal palpation cannot be carried out, as it usually can in the pelvis. It is being tried out extensively in abdominal and pelvic cases, and the results attained will determine its place in pelvic diagnosis. When under consideration in any case the advantages and disadvantages should be carefully compared with those of abdominal incision.

Through Incision.— Abdominal incision permits thorough inspection of different sides of a growth, and in addition allows palpation of the lesion, breaking of adhesions and detailed exploration to determine definitely whether or not removable, and removal if such is found feasible. When finished, the surgeon knows definitely the character of the mass and whether or not re-
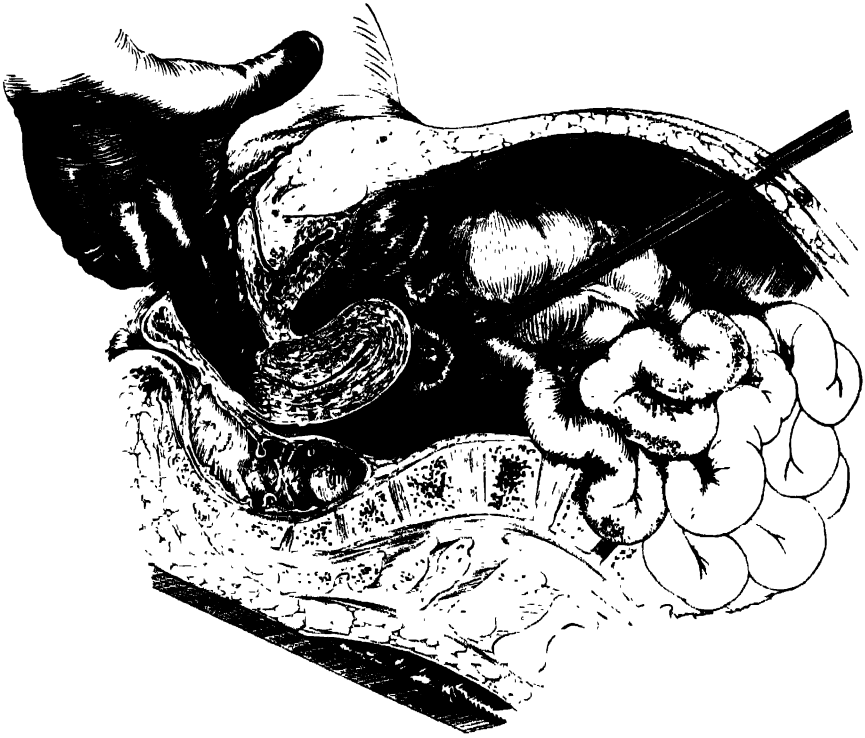
Fig. 312.—Peritoneoscopy, with a special endoscopic tube and pneumoperitoneum. The pelvic structures may be moved by fingers in the vagina to bring different parts into view. (Ruddock—*Surg., Gynec. & Obst.*)

movable and if so it has been removed. If not removed, the family knows beyond a doubt that it is irremovable and that no further operative work is advisable. The decisive thing, in choosing between peritoneoscopy and regular incision, is not simply how much can be seen through a tube in a puncture-wound but which procedure will be most beneficial to the patient when everything is considered.

Endocrine Investigations

The various extragenital examinations mentioned in the list of examination measures belong to general medicine, where the methods are given in detail along with the diseases concerned. It seems advisable, however, to make particular mention here of endocrine disturbances. Endocrine deficiencies caus-

ing pelvic disorder are sometimes first recognized by some general manifestation. These signals should be known and heeded in seeking the cause of pelvic disturbance and planning treatment.

There are certain bodily changes that point to serious endocrine disturbances having a bearing on the origin of pelvic symptoms. These disturbances are due to defective functioning of the system of endocrine glands—the normal

Fig 313.—Diagnostic facial signs in myxedema (hypothyroidism). Before treatment (left) and after treatment. (Engelbach—*Endocrine Medicine*, Charles C Thomas.)

Fig. 314.—Same patient as shown in Fig. 313, side view. (Engelbach—*Endocrine Medicine*.)

balance of influences being disturbed by hypoactivity or hyperactivity of one or more glands, with resulting reactions on the remaining parts of the system.

Thyroid disturbance is a very frequent endocrine disorder affecting the functioning of the pelvic organs. In regard to diagnosis, the pulse and blood pressure are, of course, recorded as part of the general check-up, and indicate the general physical tone of the patient, in addition to any special significance of other findings. Ascertainment of the basal metabolism rate is indicated when

the pulse is rapid and the patient on nervous tension, as shown by being excitable and "jumpy." In such cases it is important to know whether or not hyperthyroidism is present in planning treatment, and particularly before undertaking any serious operation.

In depressed individuals, always tired and never buoyant, the basal metabolism test often shows a depressed state of metabolism which can be greatly improved by the judicious administration of thyroid, with consequent improvement in pelvic disturbances. In the menopause period especially, hypothyroidism is a frequent complicating condition, and must be recognized and treated along with other endocrine troubles (Figs. 313, 314).

In regard to other endocrine disturbances, the complexity of the endocrine system and the various direct and indirect actions and reactions produce mixed clinical pictures. Confusing contradictions are met in the symptomatology of many cases, and a comprehension of any case requires considerable knowledge

HYPOANTUITARISM   HYPOTHYROIDISM   NORMAL   HYPOGONADISM   ADIPOSOGENITALISM
COMPARISON OF VARIOUS ENDOCRINOPATHIES WITH NORMAL – ALL AGED 9 YEARS.
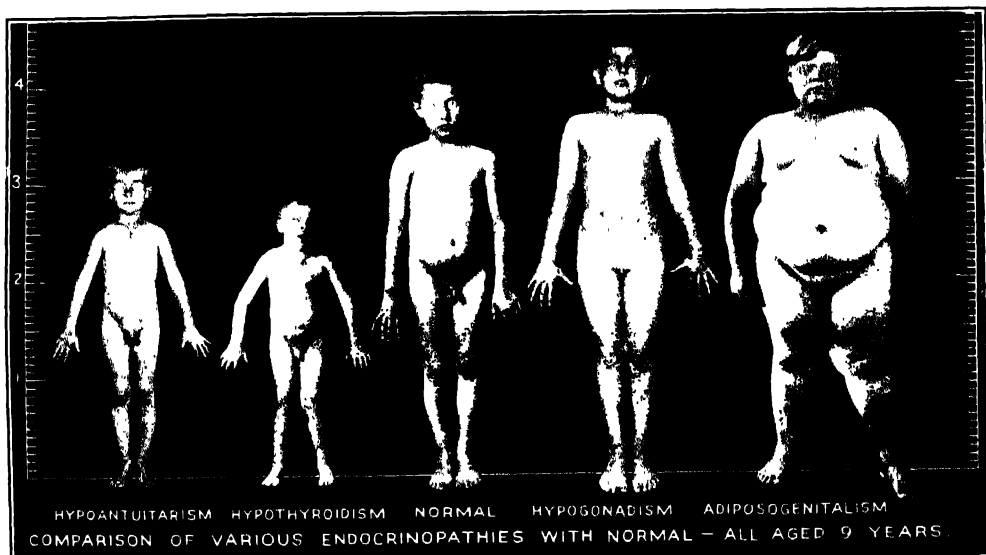
Fig. 315.—Showing striking characteristics of various endocrinopathies in patients of the same age (9 years) compared to normal child (center). (Turner—*Southern M. J.*)

of the whole subject. All we can hope to do here is to point out certain general signs which should arrest attention, and lead to detailed study of the case along these lines.

In childhood endocrine disorders produce their most serious and irremediable effects, and it is important to watch for them, particularly as the age of puberty is approached. Fig. 315 shows four children with endocrine disturbances compared with a normal child of the same age. In both sexes there is close coordination between the gonads and the general endocrine system, and disturbances centering in one or the other give rise to a great variety of symptomatic patterns.

The development of the underlying disorder is so gradual that it may be overlooked. The patient comes complaining of some apparently minor disorder, such as delayed beginning of menstruation or missing at times or exces-
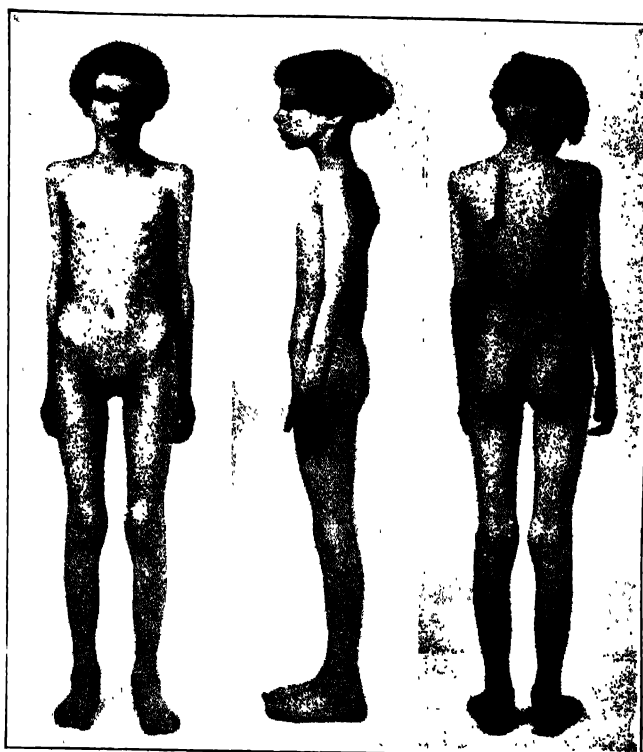
Fig. 316.—Primary hypogonadism in a fourteen-year-old girl. Note the eunuchoid build, absence of primary and secondary sex characteristics and malnutrition. (Turner—*Southern M. J.*)
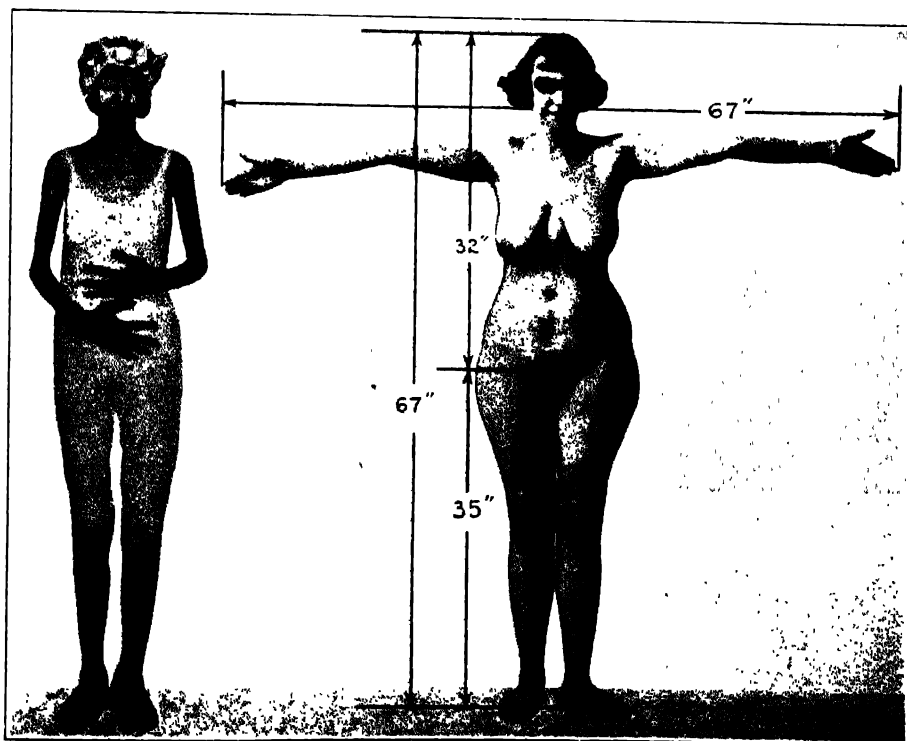
A.   B.

Fig. 317.—Primary hypogonadism, (*A*) before treatment, (*B*) six months after replacement therapy. Note the classical eunuchoid measurements: height equalling span; lower exceeding upper. (Engelbach—*Endocrine Medicine*, Charles C Thomas.)
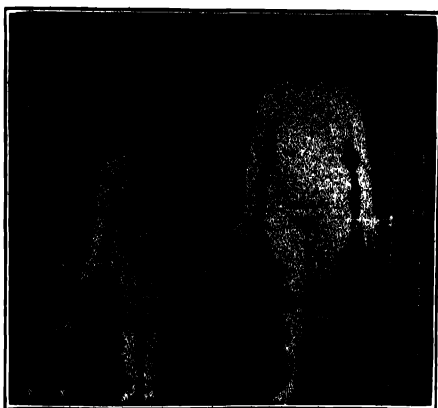
Fig. 318.

Fig. 319.

Fig. 318.--Hypoantuitarism (left), aged twenty years, compared with adiposogenitalism, aged thirteen years. (Turner—*Southern M. J.*)
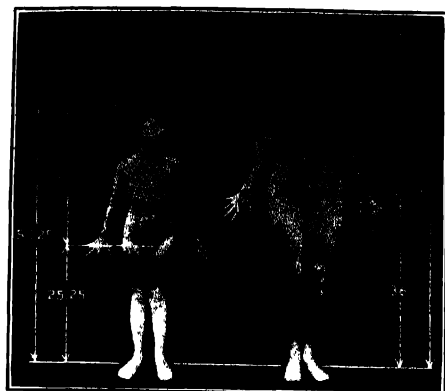
Fig. 319.--Hypoantuitarism (left), aged sixteen years, compared with hyperantuitarism aged ten years. Contrast dwarfism and agenitalism with statural and genital overdevelopment of the latter (Turner—*Southern M. J.*)
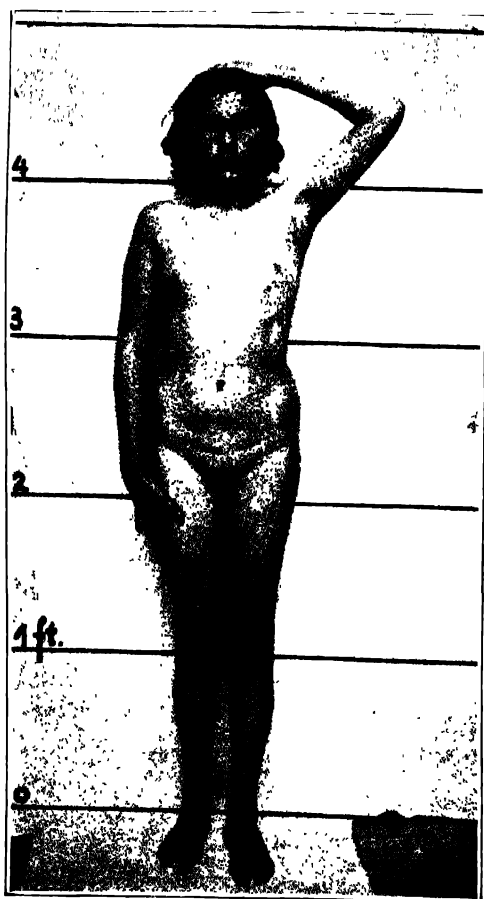
Fig. 320.

Fig. 321.

Fig. 320.—Pituitary dwarfism, Lorain-Lévi type.
Age, eighteen years; height, 4 feet, 8 inches; gracile build; weight, 84 pounds; progeria; never menstruated; poor development of secondary sex characters. Patient has large, eroded sella, but no eye symptoms. To be operated upon. (Frank—*Endocrine Aspects of Gynecology,* Thos. Nelson and Sons.)
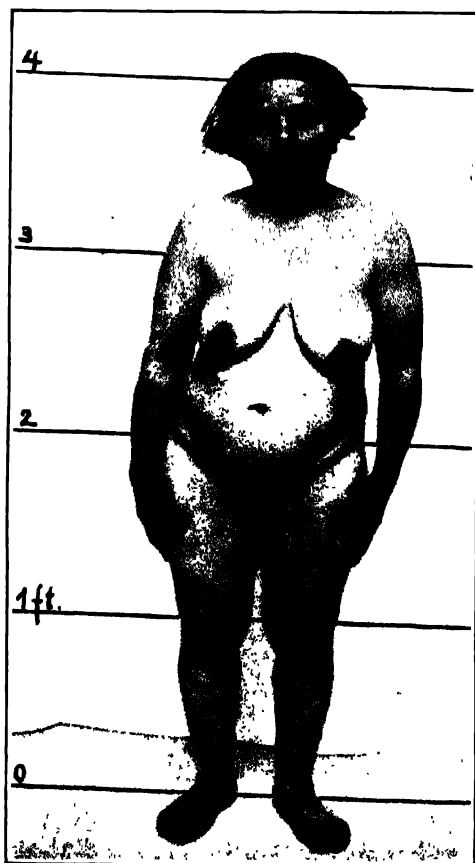
Fig. 321.—Pituitary dwarfism, Fröhlich type.
Adult female, 4 feet, 3 inches in height; deficient pubic and axillary hair; amenorrhea; sterility. (Frank—*Endocrine Aspects of Gynecology.*)

sive menstruation, with perhaps an incidental remark that she is too stout or too thin. Fig. 316 shows an amenorrheic girl of fourteen with serious functional disorder of the pituitary and gonads. Fig. 317 shows what recognition of the trouble and appropriate treatment can do, even though treatment was begun too late to change the bony maldevelopment.

In Figs. 318 to 321 are shown departures from normal statural development resulting from unrecognized, and hence long-continued, pituitary and gonadal endocrine disorders. Hirsutism, or abnormal hair development on face and body, called also hypertrichosis, may be caused by gonadal disorders of

Fig. 322.   Fig. 323.

Fig. 322.—General hirsutism from an arrhenoblastoma of the ovary.
Fig. 323.—Disappearance of excess hair after removal of the ovarian tumor. (Maxwell—West. J. Surg.)

various types. The particular location and distribution of the abnormal hair indicates whether the gonadal disturbance is of the hypertype (increased femininity) or of the hypotype (tendency to masculinity). Fig. 322 shows development of general hairiness due to an arrhenoblastoma of the ovary. Fig. 323 shows the return to normal after removal of the tumor.

Endocrine cases present certain history items and examination findings which identify them. Some of this information is brought out in the ordinary history and examination, while some requires special inquiry and investigation.

The items of special importance in the differentiation are as follows:

1. History items of special importance:
   a. Menses: age of onset, regularity, duration, amount.
   b. Weight: loss or gain, with time involved.
   c. Hair: texture, distribution, premature graying or undue falling out.
   d. Headaches: locations, type, duration.
   e. Vision: glasses necessary or other disturbance.
   f. Gastrointestinal symptoms.
   g. Nervous symptoms: irritability, depression, crying spells.
   h. General symptoms: Does patient tire easily? Is she sleepy most of the time? What are her habits of sleep, exercise, work about the home, study, recreation at home, vacation activities?

Examination items of special importance:
   a. Type of build: measurements symphysis to floor, symphysis to crown, span from finger tips to finger tips.
   b. Lean or fat; if fat, note distribution.
   c. Secondary sex characteristics: hair distribution and texture, breast development, vulvar hair growth and development of parts (labia, clitoris).
   d. Blood pressure and pulse; basal metabolism rate.
   e. Findings in the vaginoabdominal and rectoabdominal palpation. Is the uterus fully developed in size and location (well forward) or is it very small and still in backward position, with tendency to prolapse on exertion?

From the gynecologic standpoint it is convenient to group clinical pictures under two main headings: hypogonadism and hypergonadism. At first thought it may seem that these two opposite conditions should present clear-cut clinical pictures, with opposed symptomatology; but such is not the case, and a second thought will show reasons for the confusing mixture of symptoms. Gonadism represents the activity of the gonad gland (ovary in female and testis in male) with the influences back of it, and the primary and secondary changes which its activity produces. The normal activity of the ovary and testis is opposed in some particulars. Some things which are normal in the male constitute abnormal symptoms (masculinity) in the female, and vice versa.

Hypoactivity of the gonad causes a masculine shift in the female and a feminine shift in the male. On the other hand, hypoactivity of the anterior pituitary (the activator of the gonads) produces some effects (growth disorders, etc.) which are identical in male and female and other effects (through the gonads) which are opposite in male and female.

Still another item to be considered is the fact that potentially testicular cells are found in the ovary and potentially ovarian cells in the testicle. Now in such a female patient, the symptoms of masculinity may be due to hypogonadism affecting the female cells or to hypergonadism affecting the male cells. In this individual, hyperfunction of the anterior pituitary may produce femininity or masculinity, depending on which group of cells in the complex ovary is most stimulated. Also some conditions, for example a tumor, may at first stimulate cells to hyperfunction and later destroy them, producing hypofunction, with a resulting shift in the symptomatology. Furthermore, the structural changes, which are such a striking feature in certain endocrinopathies, depend to some extent on the age of incidence of the disease. Tallness (due to delayed union of long-bone epiphyses), which is characteristic of hypogonadism of early incidence, will be absent in a case in which the hypogonadism does not come on until after epiphyseal union.

These various possibilities must make one cautious in interpreting the significance of the symptoms and signs encountered—even of the marked ones which are so striking that it would seem they should be pathognomonic of some particular lesion. However, the following classification should aid materially in the understanding of the diagnostic significance of the signs and symptoms presented by these patients as they come to the office seeking treatment.

TYPES	CAUSES	SPECIAL SYMPTOMS
HYPOGONADISM *Genital Symptoms* Menstruation absent or scanty. Sterility or miscarriages. Libido absent or diminished. Poor development of genitals and sex characteristics. Tendency to masculinity. Deficiency in sex hormones. *General Symptoms* Weak, tired, atonic. Poor appetite and tendency to nausea, vomiting. Basal metabolism normal or low. Structural signs depend on type (ovarian, pituitary, thyroid, or adrenal).	Primary (ovary at fault) — Underfunction of ovary	If early—patient thin, poorly muscled. Delayed union of long bone epiphyses, tall, longer below pubes than above (Figs. 316, 317, *A*).
	Castrated or menopause	Tendency to obesity and neurovascular disturbances (hot flushes, depressed).
	Arrhenoblastoma	Masculinity tendency is marked.
	Secondary (other glands at fault) — Pituitary	Anterior lobe (hypoantuitism) If early—dwarfism. (Figs. 315, 318 to 321.) Bilobar (adiposogenitalis) Marked adiposity, early and persistent (adiposity of childhood and adolescence).
	Thyroid (hypothyroidism)	Depressed, easy to weep or be irritated. Fat deposits, coarse hair, myxedema. Basal metabolism low and blood pressure low. (Figs. 313, 314.)
	Adrenal (tumor late stage)	Masculinity—marked development of male characteristics.
HYPERGONADISM *Genital Symptoms* Early sexual maturity. Free menstruation. Fertile. Libido increased. Excess of sex hormones. *General Symptoms* Energetic, hyperactive. Good musculature. Normal fat. Basal metabolism normal or high. Structural changes depend on type (ovarian, pituitary, thyroid, adrenal)	Primary (ovary) — Overfunction of ovary	Excess menstruation. Endometrial hyperplasia.
	Granulosa-cell tumor	In early life—precocious sexual development. Short, stocky. After menopause— renewed sexual activity.
	Secondary (other glands) — Pituitary (hyperantuitism)	Statural overdevelopment, gigantism. Tall, well-muscled, no excess fat. Sexual overdevelopment (feminine). (Fig. 319.)
	Thyroid (hyperthyroidism)	Mixture of hyperthyroid symptoms with sexual speeding-up.
	Adrenal (tumor early stage)	Hypertrichosis (Fig. 322) and usually a tendency to male type. Musculature firm, athletic type. Some adiposity. Early epiphyseal union, short, stocky.

Pregnancy Tests

When the diagnosis of pregnancy is not clear from the physical examination signs, there are two courses to follow in obtaining additional diagnostic information. When there is no urgency, a wait of four to six weeks and another examination will probably settle the matter without the expense of special laboratory tests. When there is urgency, on account of the pelvic condition or the patient's anxiety to settle the uncertainty, there are reliable tests which aid in the diagnosis.

These tests are based on the fact that pregnancy increases the manufacture of the pituitary-like gonadotropic hormone, which consequently is found in excess in the body and in the body excretions, such as the urine. This hormone has the property of stimulating ovulation and corpus luteum formation

in the quiescent ovaries of animals into which it is injected. It resembles, but is not identical with, the gonadotropic hormones of the anterior pituitary gland, and is supposed to be of placental origin.

The test is made by injecting an animal (mouse, rabbit, rat) with urine from the supposed pregnant patient. The animal is killed after a certain interval (usually 36 to 48 hours) and the ovaries are examined for evidences of ovulation and corpus luteum formation. As these appear normally in the animal when cohabiting, care must be taken to separate the test animals from the males or use immature animals. As an additional precaution, and to avoid confusing conditions from previous ovulations, immature animals are usually used.

As to diagnostic reliability, it must be kept in mind that the test is not for pregnancy directly but for a certain hormone in quantity which is usually due to normal pregnancy, but which may be present also in various abnormal conditions associated with pregnancy and even in conditions in which there is no pregnancy and has been none for many months. Such quantity reactions in the nonpregnant are due to the persistent activity of isolated fetal cells remaining from a former labor or abortion, usually in the form of a chorio-epithelioma in the uterus or elsewhere. When such a tumor is present, the hormone may run to enormous quantities, far exceeding that of normal preg- nancy. Another point is that the diagnosis of pregnancy depends on the amount of reaction. The reaction in the animal ovaries must be marked, for smaller reac- tions may be caused by ordinary ovarian tumors and other nonpregnant condi- tions. Other possible sources of error are the animal and the technique employed. With these precautions the Aschheim-Zondek test and its modification by Fried- man have proved remarkably reliable in both the ''positive'' and ''negative'' phases, running 94 to 98 per cent correct in large series of cases.

Aschheim-Zondek Test. This pregnancy test, reported in 1928 and critically tested since then, uses immature mice of a certain age-weight, and five of these are given a subcutaneous injection of one-half c.c. of the filtered urine three times daily. In four days after the first injection the five mice are killed and the ovaries inspected for evidences of ovulation and corpora lutea. In two thousand tests carried out by Aschheim, he obtained the remarkable accuracy of 98 per cent correct positive reactions and 99.5 per cent correct negative reactions.

Friedman Test. This modification of the Aschheim-Zondek test was re- ported in 1929. It uses a rabbit instead of the five mice. The details, various modifications, points of special interest and reliability of this test and the Aschheim-Zondek, are given in an instructive article by Weisman, from which the following quotation is taken:

''*Comparison of the Aschheim-Zondek and Friedman Tests:* Many laboratory workers adhere to one or the other of the two tests, and it is simply a question as to which test one is accustomed. Aschheim and his followers maintain that the mice are infallible while Friedman and his supporters claim that the rabbit is more advantageous because the test is quicker, more economical and the rabbit is less easily killed by toxic substances and less bothersome as a test animal.

''In summarizing the comparative value of the two tests Crew states that both the Aschheim-Zondek and the Friedman tests are 99 per cent perfect. Crew maintains that 'a 90 to 95 per cent accuracy is not sufficient. . . . No test which yields more than 1 per cent of error can claim much support.' Dawson finds the mouse and the rabbit tests 99 per cent correct and positive within fourteen days after conception. Mack and Agnew

compared the two tests in 1,110 cases and found them equally exact. As more refined tech-
niques are being introduced the personal error in each case will eventually dwindle and
both tests at some future date should prove 100 per cent accurate in trained hands.''

Randall, Magath and Pansch reported 645 patients who had the Friedman
test, most of them because of doubtful conditions. This was a severe try-out,
but there were only 17 patients (2.63 per cent) in which the ultimate diagnosis
was at variance with the test result. This report is particularly valuable
because of the special consideration of the patients who had some condition
which interfered with the reliability of the test.

McCullagh and Cuyler discuss positive Friedman-test reactions in non-
pregnant states. They obtained 241 positive Friedman tests in 2,134 individ-
uals in whom neither pregnancy nor evidence of chorionic tissue was present.
Though the test is extremely accurate and helpful, it must be remembered that
occasionally nonpregnant conditions give a positive reaction. Hence the sig-
nificance of the result of the test must be evaluated in conjunction with the
clinical findings—that is, before deciding that a positive reaction means preg-
nancy we must exclude other conditions that may cause it.

In the extensive series in their instructive report, McCullagh and Cuyler
found a positive reaction without pregnacy in various disorders of the pitu-
itary, in gonadal deficiencies (as in the climacteric, at puberty, in functional
ovarian disturbances, in ovarian tumors, and in men with testicular deficiency),
in other endocrine disorders (hyperthyroidism, diabetes mellitus, adrenal hy-
perfunction or tumor), in depressed nutritional states with local manifesta-
tions such as skin and eye disturbances, and in disorders of the nervous system
(epilepsy, hysteria, psychoses, arterial hypertension, and anorexia nervosa).

Other Pregnancy Tests. There are many other forms of tests. In fact, a
large literature has grown up in the strenuous efforts to try out all possible
ways and substances which offer hope of a simpler or quicker test for preg-
nancy. In modifications of the pituitary-like hormone tests other animals are
used, including rats, guinea pigs, fish, and frogs. Other reactions also are used
in some cases, for example, variations in skin coloration as in fish and frogs.
Male animals have been used as in fish (color variation) and in rats and mice,
injection of pregnancy urine causing changes in the seminal vesicles. Protozoa
have been used, by observing under the microscope their actions on the addi-
tion of a drop of pregnancy urine. One reported test is based on the effect of
pregnancy urine on the sprouting of seeds.

Much work has been done on a test based on the intradermal injection
of antuitrin-S, which is made from pregnancy urine. This is known as the
skin test or intradermal test, and is dependent on an allergic or other reaction
to the injection when there are excess pregnancy hormones in the circulation.
Another type which looms large in the literature depends on chemical testing
of the patient's urine for the pituitary-like gonadotropic hormones and for
other substances (Visscher-Bowman test and others). Special chemical sets
for such tests have been devised for general use. Various types of pregnancy
tests and also other articles on the subject will be found in the Reference List.

Many other hormone tests are used in endocrine investigations and diag-
nosis and treatment, but there is not space here for this complicated laboratory
work, details of which can be found in listed articles.

GYNECOLOGIC TREATMENT MEASURES

In planning treatment for a patient with a pelvic disorder it must be kept in mind that in many instances the pelvic disturbance is only the local manifestation of some general functional derangement, and that even in the case of a strictly local lesion adequate general functioning is necessary to full local restoration. This fact, so important in planning effective treatment, is becoming more and more evident as modern research reveals the details of the interlocking system of endocrine, vitamin, and other nutritional controls.

Treatment of the gynecologic patient therefore must begin, like the examination, with attention to general conditions. This is to avoid wasting time and expense on prolonged treatment for some local disorder the clearing up of which can be attained only by a combination treatment correcting also other serious derangements. The hasty dosing with ovarian hormones for all pelvic ills is a case in point, and the same may be said of the easy yielding to the indiscriminate and prolonged use of many other remedies which the obliging salesman highly recommends for disorders about which he is blissfully ignorant.

Having ascertained that the patient is in good general condition or arranged for adequate care of any obvious deficiency in that direction, we are ready to consider what additional measures may aid in removing the pelvic disturbance. These special therapeutic aids may be grouped under the following headings:

> Endocrines
> Vitamins
> Bactericides
> Hemostatics
> Plasma Balance
> Allergy Treatment
> Thermotherapy (fever therapy and refrigeration)
> Neurotherapy and Psychotherapy
> Local Measures

How do these various remedies bring about desired changes in pelvic functioning? The determination of the details of changes brought about in tissues and functioning by different medicines belongs to the large subject of pharmacology. While there is not space here for consideration of this general feature of therapy, it is well to call attention to its importance in the understanding and rational application of the various remedial agents. Functioning of the internal organs is conditioned largely by the autonomic nervous system, which has a set of accelerator (motor) fibers and inhibitory fibers extending to all organs. This involuntary nerve-control apparatus governing function is acted upon by different remedies in different ways, the details of which have

been worked out by pharmacologic investigation. Fig. 324 shows the intimate connection between the autonomic nerve terminals and the effects of certain medicines. Somewhat similar connections between minute anatomy and physiology and remedial action extend to many remedies employed. Not all medicines act through the nerves; some produce their effects directly on the functioning cells.

Incidentally, such studies, extending throughout the great field of experimentation, bring us ever nearer to that most interesting contact-point where minute structural change becomes functional manifestation. Ordinarily we think of structure as something fixed, visible, palpable, with function as the evanescent, formless, nonmaterial result. The great problem of modern medical research is the determination of exactly what takes place in the cell to produce
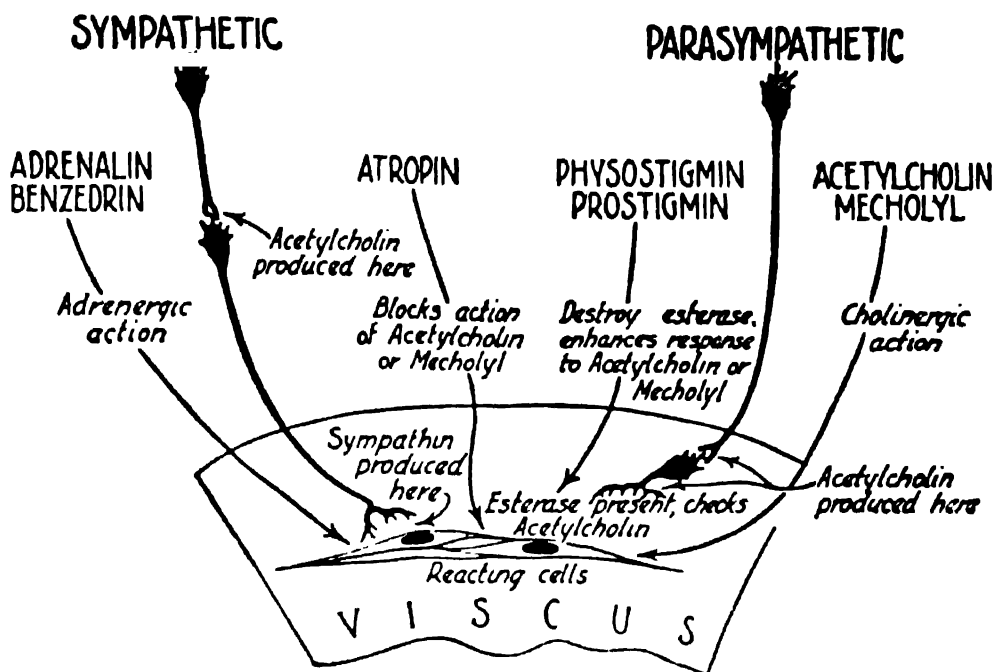
Fig. 324.—Presentation by Myerson of the working hypothesis of human autonomic pharmacology. (Myerson—*J. A. M. A.*)

each of the multitude of normal functions (physiology) and of abnormal results (pathology) and of remedial effects (pharmacology). Hence the shift in emphasis, in study and teaching, from the gross structure to that minute and still strictly-censored manufacturing plant, the cell.

Though not all connections between remedial agents and their results have been worked out, the study of those that are known is important for the most effective treatment in any field.

The purpose of this chapter is to give a general view of the remedial resources available for the correction of disturbances in this field and also some indication as to the types of disturbance amenable to certain classes of remedies. The application of therapeutic measures to the treatment of particular diseases will be discussed in the chapters on those diseases.

ENDOCRINES

Endocrine therapy is useful in many functional disturbances of the genital tract and in some organic diseases. The hormones particularly concerned in gynecologic disturbances are considered in the following order: thyroid, parathyroid, pituitary and placental, ovarian, testicular, adrenal, pancreatic (insulin). Standardized preparations of the hormones having gonadal effects are given later in the table.

Thyroid Hormones

The interrelationship between the thyroid and the gonads has long been recognized, and thyroid has been used in sterility, amenorrhea, dysmenorrhea, and menorrhagia. The mechanism of this relationship, however, is not so well understood. Numerous methods have been used to study the relations, and many facts have been determined, including the following: (a) estrin increases the basal metabolism in ovariectomized women; (b) estrin decreases the basal metabolism in ovariectomized rats, in hyperthyroid rats, and in normal guinea pigs and rabbits.

The effect of the estrogens on the thyroid is probably indirect, through the inhibitory action on the pituitary.

Parathyroid Hormones

A relationship between the female sex hormones and the parathyroids is known to exist, though the mechanism is still obscure. Postthyroidectomy tetany rarely occurs in men. Attacks of tetany are frequently associated with the menstrual cycle, and in cases of chronic tetany the acute attacks occur regularly at menstruation. A study of the calcium and phosphorus blood levels reveals very little deviation from the normal. The sex hormones evidently affect the neuromuscular excitability in human parathyroid tetany through a separate mechanism. The diminution of ovarian activity by radiation helps to control the aggravating symptoms in selected cases.

Pituitary Hormones

The pituitary hormones have been discussed at length in Chapter I. The chief ones used in treatment are the gonadotropins—those derived from the pituitary itself and those derived from the placenta. The latter are called chorionic gonadotropins and they come from two sources, the urine of pregnant women and the serum of pregnant mares. Their uses in menstrual disturbances and in sterility are discussed in the appropriate chapters.

Ovarian Hormones

The *follicular* or estrogenic hormones used in therapy, given in approximately their ascending order of effectiveness in clinical use, are: estriol, estrone, estradiol, estradiol benzoate, estradiol dipropionate.

Since the isolation of estradiol from follicular fluid it is generally conceded to be the true follicular hormone found in the ovary. Estrone, or theelin, and estriol, or theelol, are excretion products of dihydroxytheelin, or estradiol. A benzoic acid ester of estradiol that has been prepared synthetically is more effective than estradiol because it facilitates the use of a larger dosage and the effect is prolonged. Because of the confusion in dosage designation caused by the introduction of these two synthetic substances, each with a different criterion for standardization, an explanation of the present status of dosage is given.

One international unit of estrone has a specific estrus-producing activity of $\frac{1}{10,000}$ mg. of the crystalline estrone standard, hence 1 mg. of estrone equals 10,000 international units. The dosage of crystalline estradiol is expressed in Allen-Doisy rat units, or by weight, 1 mg. equals 12,000 rat units. No international unit has been established for estradiol. Estradiol benzoate is standardized in Allen-Doisy rat units and also in international benzoate units. One international benzoate unit has an estrus-producing activity of $\frac{1}{10,000}$ mg. of a standard preparation of estradiol benzoate. One rat unit of estradiol benzoate is approximately equal in activity to two international benzoate units.

The hormones mentioned are used chiefly for the treatment of menstrual disturbances and sterility and troublesome climacteric symptoms.

In addition to the follicular ovarian hormones (natural estrogens) there are certain other preparations having estrogenic effects—for example, stilbestrol, octofollin, and hexestrol. Stilbestrol (diethylstilbestrol) is a synthetic substance related to the stilbenes. It has an estrogenic potency three or four times that of estrone, and also is relatively inexpensive. It has certain disagreeable toxic effects with some patients (nausea, dizziness, etc.). However, these may usually be avoided by (a) limiting the dosage to the minimum required to control the symptoms (ordinarily ½ mg. or less daily), (b) giving the dose at bedtime, and (c) interrupting the treatment at regular intervals as mentioned under Methods of Administration (page 256). The advantages and disadvantages of stilbestrol are now well established by a mass of experimental and clinical reports (1943 review by Abarbanel et al.) and it is put on the market in convenient forms by various drug firms.

Hexestrol (dihydrostilbestrol) is a less potent and less toxic preparation of the stilbene group, with clinical effects accordingly. The detailed results obtained by its use in several series of cases have been reported, a 1943 report being that of McElroy, Snyder and Clark.

Octofollin (2-4-di(parahydroxyphenyl)-3-ethyl hexane) is a synthetic estrogenic substance different from the stilbene group. Several series of results have been reported, a recent one being by Roberts, Loeffel, and MacBryde, who conclude (1) that octofollin is effective in the treatment of hypogonal symptoms in women, (2) that it is relatively nontoxic, and (3) that the effective oral dose is from 5 to 10 mg. daily when continuous treatment is used or from 10 to 15 mg. daily for interrupted treatment.

The *corpus luteum* hormone (progesterone) is used intramuscularly as progesterone and orally as a hydrohydroxy-progesterone. The chief clinical uses of progesterone are for menstrual disturbances and sterility and threatened abortion.

The employment of these various hormones in particular disorders is taken up under those disorders. A helpful article on the clinical use of the ovarian hormones was recently given by Willard M. Allen (see Reference List).

Testicular Hormones

The action of the male hormone has been discussed in Chapter I. Testosterone is the most potent of the androgens. It can be given intramuscularly as testosterone propionate, by inunction as free testosterone, orally as methyl testosterone, or by implantation as testosterone.

Adrenal Hormones

The important relationship of the adrenal cortex hormones (corticosterone, desoxycorticosterone) to the sex hormones is being gradually elucidated. The

TABLE OF STANDARDIZED HORMONE PREPARATIONS
HAVING GONADAL EFFECTS

(Shows types of preparations, not complete list.)

		Theelin in oil (Parke, Davis)	0.1, 0.2, 0.5, 1.0 mg. (0.1 mg. equals 1,000 International Units)
	Estrone (Theelin)	Estrone (Lilly)	0.1, 0.2, 1.0 mg.
		Estrone (Abbott)	0.1, 0.2, 0.5, 1.0 mg.
		Amniotin (Squibb)	0.2, 0.5, 1.0, 2.0 mg.
		Estrogenic hormones (Upjohn)	0.2, 1.0 mg.
	Estrogens from pregnancy urine (Estrone, Estradiol, Equilin, Equilenin, Hippulin)	Folestrin (Armour)	0.2, 0.5, 1.0, 2.0 mg.
		Menformon (Roche-Organon)	1,000 I.U. 5,000 I.U. 10,000 I.U.
		Plestrin (Harrower)	0.2, 0.5, 1.0 mg.
ESTROGENS — Intramuscularly		Thelestrin (Carnrick)	0.2, 1.0 mg.
		Progynon-B (Schering)	500 R.U. about 1,000 I.U. or 0.083 mg. 1,000 R.U. or 0.166 mg. 2,000 R.U. or 0.333 mg. 6,000 R.U. or 1.000 mg. 10,000 R.U. or 1.666 mg.
	Estradiol benzoate	Ben-Ovocylin (Ciba)	0.1, 0.2, 1.0 mg.
		Dimenformon (Roche-Organon)	1,000, 2,000, 10,000 R.U.
		Di-Ovocylin (Ciba)	0.1, 0.2, 1.0, 2.5, 5.0 mg.
	Estradiol dipropionate	Progynon DP (Schering)	0.1, 0.2, 1.0, 2.5, 5.0 mg.
		Follarco (Schieffelin)	0.1, 0.2, 0.5, 1.0 mg.

ESTROGENS Continued

Orally

Estriol (Theelol)

Product	Dose
Theelol kapseals (Parke, Davis)	0.06, 0.12, 0.24 mg.
Estriol capsules (Abbott)	0.06, 0.12, 0.24 mg.
Emmenin liquid	120 Day Oral Units in 4 c.c.
Emmenin tablets (Ayerst-McKenna)	120 Day Oral Units per tablet
Estrogenic hormone capsules (Upjohn)	1,000, 2,000, I.U.
Estriol pulvules (Lilly)	0.06, 0.12 mg.
Folestrin granules (Armour)	1,000 2,000, 4,000 I.U.
Plestrin capsules (Harrower)	1,000, 2,000, I.U.
Amniotin capsules (Squibb)	1,000, 2,000, I.U.
Follarco (Schieffelin)	1,000, 5,000, 10,000 I.U.

Estradiol

Product	Dose
Progynon DH tablets	0.1, 0.5 mg.
Progynon DH solution (Schering)	60 R.U. per c.c.
Dimenformon tablets (Roche-Organon)	$\frac{1}{24}$ mg., $\frac{1}{8}$ mg.
Ovocylin tablets (Ciba)	0.1, 0.2, 0.5 mg.

Nasal Spray

Product	Dose
Amniotin in oil (Ayerst McKenna)	20,000 I.U. in 30 c.c.
Progynon DH nasal spray (Schering)	0.4 mg. (about 4,800 R.U.) per 30 c.c.

Vaginal Suppositories

Product	Dose
Theelin suppositories (Parke, Davis)	0.2 mg., 2,000 I.U.
Amniotin pessaries (Squibb)	0.1, 0.2 mg.
Kolpon inserts (Roche-Organon)	juvenile 0.05 mg. adult 0.10 mg.
Folestrin suppositories (Armour)	0.1, 0.2 mg.
Progynon DH suppositories (Schering)	juvenile 480 R.U. adult 480 R.U. 4,800 R.U. (Estradiol)
Ovocylin suppositories (Ciba)	juvenile 0.04 mg. adult 0.04 mg.

Ointment

Product	Dose
Progynon DH ointment (Schering)	360 R.U. per Gm. 1,800 R.U. per Gm. (Estradiol)
Ovocylin ointment (Ciba)	0.03, 0.15 mg. per Gm. (Estradiol)

Synthetic Chemicals with Estrogenic Action

Product	Dose
Stilbestrol tablets (various firms)	0.1, 0.25, 0.5, 1, 5 mg.
Hexestrol tablets (various firms)	0.1, 0.25, 0.5, 1, 3 mg.
Octofollin tablets (Schieffelin)	0.5, 1, 2, 5 mg.

PROGES-TERONE	Intramuscularly	Lipo-Lutein (Parke, Davis)	
		Proluton (Schering)	½ mg., 1, 2, 5, 10 mg.
		Nalutron (Winthrop)	1, 2, 5 mg.
		Progestin (Lilly)	1 mg.
		Progestin (Upjohn)	1, 2 mg.
		Progestin (Roche-Organon)	1, 5 mg.
		Progestone (Carnrick)	⅟₂₅, ⅙, ½, 1, 5 mg.
		Lutocylin (Ciba)	1, 5, 10 mg.
	Orally	Pranone (Schering)	5, 10 mg.
ANTERIOR PITUITARY GONADO-TROPINS	Intramuscularly	Preloban (Winthrop)	150 gonadotropic R.U.
		Ambinon (Roche-Organon)	50 gonadotropic R.U.
		Prephysin (Chappel)	25 gonadotropic R.U. 100 gonadotropic R.U.
		Gonadotropic Factor (Armour)	300 Collip U.
		Gynatrin (Searle)	100 R.U.
		Gonadotropic Factor (Ayerst-McKenna)	
WHOLE ANTERIOR PITUITARY	Intramuscularly	Ant. Pituitary Extract (Squibb)	
		Ant. Pituitary (Sharp & Dohme)	
		Polyansyn (Armour)	
PREGNANT MARE'S SERUM	Intramuscularly and Intravenously	Gonadogen (Upjohn)	10 Cortland-Nelson Units = 200 I.U. 20 Cortland-Nelson Units = 400 I.U.
		Anteron (Schering)	250 I.U. 400 I.U.
		Gonadin (Cutter)	200 I.U.

ANTERIOR PITUITARY-LIKE HORMONES from pregnancy urine or chorionic gonadotropin	Intramuscularly		Antuitrin-S (Parke, Davis)	120 I.U. 600 I.U.
			Follutein (Squibb)	100 R.U. Stable a year 500 R.U.
			Korotrin (powder) (Winthrop)	100 I.U. Stable indefinitely 500 I.U.
			Pregnyl (powder) (Roche-Organon)	100 I.U. 500 I.U.
			A.P.L. (Ayerst-McKenna)	100 I.U. 500 I.U. 1,000 I.U.
			Pranturon (powder) (Schering)	150 I.U. 750 I.U.
			Apestrin (Harrower)	100 I.U.

MALE HORMONES	Intramuscularly	Testosterone propionate	Oreton (Schering)	5, 10, 25 mg.
			Pernandren (Ciba)	5, 10, 25 mg.
			Neo-Hombreol (Roche-Organon)	5, 10, 25 mg.
	Ointment	Testosterone propionate	Oreton F toplicator (Schering)	2 mg. each
			Pernandren ointlets (Ciba)	4 mg. each
			Neo-Hombreol dosules (Roche-Organon)	4 mg. each
	Orally	Methyl-testosterone	Oreton M (Schering)	10 mg.
			Metrandren (Ciba)	10 mg.
			Neo-Hombreol (Roche-Organon)	10 mg.

ADRENAL CORTEX	Intramuscularly Intravenously Orally	Cortate (Schering)	5 mg. (desoxycorticosterone)
		Cortalex (Upjohn)	Extract of 5 Gm. of adrenal tissue
		Adrenal Cortex Extract (Wilson)	
		Precorten (Ciba)	5 mg. (desoxycorticosterone)

chemical formula of desoxycorticosterone is the same as that of progesterone with the addition of a hydroxyl group on the 21-carbon atom. Progesterone has been isolated from the adrenal cortex, and the life of adrenalectomized rats can be maintained by the administration of progesterone.

An androgenic substance (andrenosterone) having one-fifth the potency of androsterone has been isolated from the adrenal cortex.

Though as yet there are no criteria for the use of adrenal cortex in pelvic endocrine disorders in women, its use will probably be extended in that direction as our knowledge of its various actions is enlarged.

Insulin

Insulin, the hormone from Langhans cells of the pancreas, has been found to give relief in certain cases of dysmenorrhea. Its mode of action has not been worked out, but it has been successfully employed in patients with low, normal, and high blood sugar levels.

VITAMINS

The rapidly developing knowledge of vitamins has brought considerable aid in the handling of pelvic disorders. Fig. 325 shows the principal vitamins and their connections and time of discovery. Those of particular importance in genital tract disturbances are A, B, C, E, and K The vitamin deficiencies produce nutritional defects which lower ovarian function and, if continued, produce degenerative changes in ovarian structure.

How are these serious local nutritional effects brought about? Is it a direct or an indirect effect? The intimate relationship existing between general nutrition and vitamins and endocrines was demonstrated in this connection by Stephens and Willard Allen. They found that in guinea pigs with undernourishment sufficient to reduce body weight 20 to 30 per cent in two weeks, there were retrogressive and atrophic changes in the ovary. These were similar to those found after hypophysectomy. Vitamin supplements did not affect the result, but the administration of gonadotropic hormones did indicating that the degenerative changes in the ovary were due in part to the inability of the undernourished pituitary to produce gonadotropic hormones in sufficient quantity to maintain ovarian structure and function. Similar results of the effects of inanition on the thyroid had been demonstrated by Stephens.

Vitamin A

Vitamin A is a factor in maintaining epithelium in normal condition, and epithelial cells represent to a large extent the functioning part of each organ. The higher specialized the epithelium becomes, the earlier slight nutritional defects are lightly to be noticed. One of the first noticeable effects of vitamin A deficiency is on a specialized tissue of the eye, causing difficulty in seeing in dim light. This "night blindness" is likely to be accompanied with general lack of vigor, easy fatigue, sleeplessness, dry hair, and rough skin.

The maintenance of normal squamous epithelium depends on the normal nutrition of the basal layer, which supplies new cells as the surface cells become keratinized and cast off. Keratinization represents a normal degenerative change, but under vitamin deficiency

it becomes exaggerated to a pathological condition, which in the cornea may lead to impaired vision and even to ulceration. In the skin, the hyperkeratinization affects especially the hair follicles, causing masses of cells which plug the follicles and produce minute bumps on the skin surface resembling exaggerated "goose skin." This condition, designated keratosis pilaris, lichen pilaris, ichthyosis follicularis, etc., which with its uncomfortable, harsh, dry, itchy condition may affect the vulvar surfaces, has been shown to be due to vitamin deficiency. Lehman and Rappaport state, "Every case in the series investigated by us that might have been designated keratosis pilaris, ichthyosis follicularis or the like proved by photometric test to be deficient in vitamin A and responded to vitamin A therapy."

It was found that vitamin A deficiency produced permanent cornification of the vaginal epithelium in rats.

In castrated rats with diets deficient in vitamin A, estrus could be produced only by the administration of both vitamin A and estrogens, not by either alone. The influence of vitamin A deficiency is evidenced not only in the vaginal mucous membrane but through the gonad glands also. Sutton and Brief found a significant increase in the basophiles or "castration cells" in vitamin-A deficient rats of both sexes, indicating a partial castration effect.
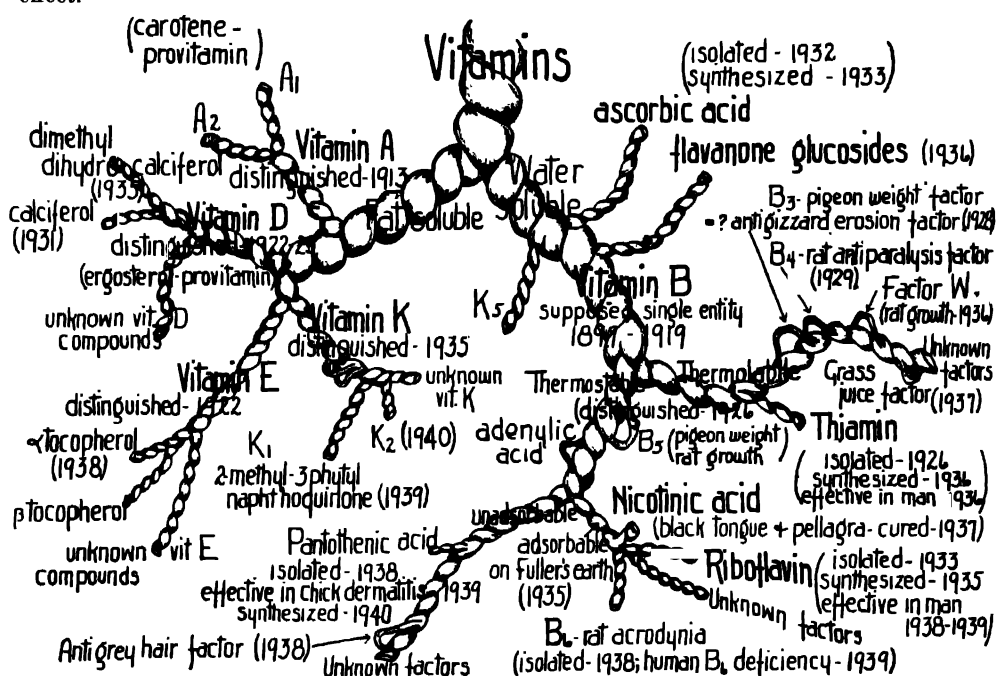
Fig. 325.—Diagrammatic representation of the interrelationship of the vitamins. They are schematically differentiated into the water-soluble and the fat-soluble fractions; the latter group is further separated into its thermolabile and its thermostable components. Certain of these substances have been shown to be essential to human nutrition and effective in the treatment of specific deficiency diseases. The physiologic properties of many are as yet undetermined. (Spies, Hightower and Hubbard—J. A. M. A.)

In the human, relief of senile vaginitis in thirty cases by vitamin A therapy has been reported by Simpson and Mason. In vulvitis due to vitamin A deficiency, the skin becomes dry and rough and later a papillary eruption appears. These papules are formed by hyperkeratosis of the hair follicles. A keratinizing metaplasia of their ducts is responsible for the absence of sweat glands. The sebaceous glands atrophy and undergo the same process. Similar lesions are present also over most of the body in advanced cases, as illustrated in the article by Lehman and Rappaport and also in dermatological textbooks.

Therapy in vitamin A deficiency consists in giving 25,000 unit capsules, ten to twelve per day. Dependable preparations are put out by reliable drug firms under different trade names. A capsule of the above potency is on the

market under the name of afaxin (Winthrop). The treatment is continued until the skin returns to normal or, with vaginitis, until the symptoms clear.

Vitamin B Complex

Vitamin B Complex is helpful in treating certain cases of neuritis, also in radiation sickness and in loss of appetite and undernourishment. These conditions are found in many gynecological patients, particularly in those having irremovable carcinoma.

Imler and Wammock gave their results in the treatment of twenty-one patients for severe radiation sickness with synthetic vitamin B_1 (thiamin chloride). Quoting from the abstract:

> They find that daily injections of 3,000 international units will, in the majority of cases, give rapid and complete relief. Infrequently a recurrence of symptoms requires increase in the dosage. One patient receiving roentgen therapy to the left side of the neck required a temporary increase to 4,500 international units daily by hypodermic injection to control the recurrent nausea and another required 10,000 to eliminate nausea and vomiting. The results obtained with the hypodermic administration are definitely superior to those following the peroral use.
>
> The treatment of outpatients presents a problem in that radiation sickness cannot be satisfactorily relieved by the oral administration of large doses of vitamin B_1. It is difficult for these patients to retain their confidence and cooperation, with the result that they fail to continue the medication as prescribed and occasionally refuse to follow the course of radiation therapy. This undesirable factor can be overcome by requiring the patient to return for daily injections of vitamin B_1. Smaller daily doses are more effective than are massive doses given on alternate days.

The dose of B_1 or thiamin hydrochloride for neuritis or malnutrition due to vomiting varies from 5 to 25 mg. daily. Nicotinic acid is helpful in the vaginitis of pellagra patients. In persistent anorexia and in vomiting the effect is often striking and most helpful.

Vitamin C

Vitamin C (ascorbic acid, cevitamic acid) is the vitamin which prevents scurvy. It is supposed to be important in wound healing. It has been reported helpful in certain cases of internal bleeding.

Wolbach states: "Vitamin C is necessary for the formation of all intercellular substances having collagen as their basis; and its absence prevents the formation of the matrices of white fibrous tissue, cartilage, bone, and dentine." In the excellent "Vitamin Reference Book" by Squibb it is pointed out that the various manifestations of vitamin A deficiency are due in part to failure of endothelial cells to form cement substance. Capillary fragility is common, and consequently minor hemorrhages are relatively common. The reduced immunologic response seen at times may be the result of the lessened ability to form collagen, a substance which aids in segregating infectious organisms. Hence in persistent infection with undernourishment in a gynecological patient, particularly if associated with a hemorrhagic tendency, the possibility of vitamin C deficiency should be considered and standard testing carried out, that vitamin C therapy may be instituted if needed.

Vogt reported that gynecologic hemorrhages in the young may be effectively treated by oral or intravenous administration of cevitamin acid, the

hemorrhage usually stopping after the first injection. Stephens and Hawley reported that large amounts of orange juice given to four patients with hemophilia and two with chronic thrombocytopenic purpura had no effect on the hemorrhagic manifestations, blood picture, or capillary resistance. Boeger and Schroeder found oral administration of vitamin C ineffective, while intravenous use stopped the bleeding and increased thrombocytes.

Vitamin E

Vitamin E has been called the antisterility vitamin. It is supposed to be an aid to fertility, particularly in the prevention of habitual abortion. There is much variance of opinion on the efficacy of vitamin E in sterility and in threatened abortion, but there are enough reliable reports to indicate that it is definitely helpful in these cases. Shute has made extensive reports on the use of wheat germ oil in threatened abortion and also in senile vaginitis of certain types, and from his extensive experience he concludes that it is exceedingly helpful. Saturation of the patient stopped the bleeding and uterine tenderness promptly in many cases of threatened abortion, and when the germ oil therapy was stopped the bleeding and uterine tenderness returned.

Since the synthesis of vitamin E its potency has been increased about 170 times. Most of the commercial products contain a mixture of alpha and beta tocopherols. Some of the newer products are tocopherex (Squibb), tofoxin (Winthrop), ephynal acetate (Hoffman-LaRoche).

Vitamin K

Vitamin K is the coagulation vitamin, which regulates the clotting of blood and the control of bleeding. It is designated the "coagulation factor" because it appears necessary to the formation of prothrombin. It was named "K" by its Danish discoverer (Dam) after "Koagulation," as they spell it. Vitamin K deficiency occurs mostly in patients with obstructive jaundice; persons able to handle ordinary balanced diets usually get a sufficient amount apparently. Experiments indicate that the exclusion of bile from the intestine prevents the absorption of vitamin K in the food taken. Hence when administering vitamin K orally, bile salts also must be given.

Its administration preoperatively is indicated in gynecological patients when the clotting time is prolonged, and especially if there is any tendency to jaundice. More recently it has been found to increase the prothrombin in newborn babies suffering from hemorrhagic disease, and its use is advised as a prepartal procedure during the last several weeks of pregnancy. Whether it will be helpful in other types of bleeding has not yet been definitely determined. Some of the commercial preparations are Synkamin (Parke, Davis), Thyloquinone (Squibb), and Quino-thrombin (Lederle).

General Remarks on Vitamins

Before passing from the subject of vitamins it may be well to call attention to certain general points. These are mentioned in Squibb's vitamin book previously referred to. Clinically recognizable single vitamin deficiencies are rare, but there are many cases of mixed deficiencies involving two or more

vitamins. Also, it is not the clear-cut advanced avitaminosis that is encountered, but mild grades that may be classed as subclinical.

The high incidence of subclinical vitamin deficiency disorders indicate the necessity of adjusting diets where possible, and of providing vitamin supplements where modification of the patient's dietaries is impracticable. The vitamins may be ranked as follows in order of their probable deficiency:

1. Vitamin D: Because it has the most limited distribution.
2. Vitamin B₁: Because it is stored only to a limited extent, and effects and symptoms of subclinical B₁ avitaminosis are fairly common.
3. Vitamin A: Because it occurs for the most part in the relatively more expensive foodstuffs, and hence is apt to be lacking in many diets.
4. Vitamin C: Because the changing food habits of recent years suggest that, except in the case of infants, there is not likely to be a deficiency of this vitamin.
5. Vitamin E: Last, because the general opinion seems to be that average diets supply a sufficient quantity of this factor.

BACTERICIDES

There are classes of remedial agents directed particularly against invading bacteria. Such invasion may be checked by direct lethal effect on the bacteria or by strengthening the defensive forces of the body so that they accomplish the task. These remedies may be grouped under three headings: bactericidal drugs (chemotherapy), antitoxin and serobacterin treatment, and foreign protein treatment.

Chemotherapy

In recent years there have been developed certain drugs of the sulfonamide group which by direct or indirect action assist in overcoming infectious processes. These new remedial agents have revolutionized the therapy of infections. They have special indications and contraindications, mentioned in the literature of each, which must be carefully considered when using the drug. Under proper supervision and precautions large doses have been given without harm and with great benefit in various kinds of serious infection, including peritonitis and blood-stream infections. The danger signals are: dizziness, cyanosis, nausea and vomiting, anemia, leucopenia, and fever which appears between the seventh and tenth days of therapy after a preliminary drop in temperature.

Sulfathiazole is specially effective in gonorrhea. Sulfadiazine is less toxic in large dosage, and the troublesome precipitation of crystals in the urinary tract may be prevented by alkalinizing the urine and giving plenty of water (Gilligan, Garb, and Wheeler). Sulfamerazine has the same advantages and disadvantages as sulfadiazine with somewhat smaller dosage requirements (Hall and Spink).

Penicillin, the remarkable antibacterial agent from common mold, has proved effective in cases resistant to the sulfonamides. However, nearly all is still required by our armed forces, though every effort is being made to increase production so that civilian requirements also may be supplied.

Antitoxin and Bacterin Treatment

The most striking and certain effects of antitoxin therapy are seen in the cure of diphtheria by diphtheria antitoxin and the prevention of tetanus by antitetanic serum. Antistreptococcic serum has occasionally proved beneficial in puerperal infection and in other forms of acute streptococcic invasion.

Bacterin treatment, or vaccine treatment as it is frequently designated, is based upon the idea of creating active immunization by stimulating the formation of antibodies by injecting killed bacteria or their products in increasing doses. Stock bacterins were used and also autogenous bacterins made from cultures from the patient.

In an endeavor to lessen the marked reaction (fever, etc.) associated with bacterin treatment, bacterin preparations have been treated with corresponding immune serum. Such a treated preparation is designated "serobacterin" or "sensitized" vaccine. There is much less reaction, and the diminution of the troublesome reaction is supposed not to interfere with the stimulation of antibody formation. On account of less reaction, the serobacterins may be used freely, even in very ill patients in whom the bacterin reaction was sometimes dangerous. Another advantage of the serobacterin or immunized vaccine is that the immunity begins at once, while with the plain vaccine eight to ten days are required for the development of immunity, and time is an important factor in effective aid when the body defenses are being overwhelmed by acute infection.

These immunized vaccines are put out under various trade names, such as serobacterins (Mulford) and immunogens (Parke, Davis). The results of treatment with bacterial vaccines have been variable. Some serious cases have been greatly benefited while in others there seemed to be no effect. The fact that this treatment seemed to turn the scales favorably in some desperate cases of blood stream infection, indicates its employment in those cases not yielding to the newer bactericidal drugs and other measures.

In addition to specific bacterins (made from the kind of organism or organisms supposedly responsible for the infection), nonspecific bacterins may be employed, for example typhoid vaccine or colon bacillus vaccine. This method of producing the "nonspecific shock" which arouses the defensive mechanism of the body has been used as a substitute for the foreign protein treatment (described next) to avoid the allergic or anaphylactic reaction of milk or other protein in large quantity.

Krieg reports his experience with 172 patients so treated, using colon bacillus vaccine. The sterilized suspension of colon bacilli was given by intradermal injection. A "series" consisted of six injections, given two injections per week, starting with $\frac{1}{4}$ c.c. and increasing $\frac{1}{4}$ c.c. with each injection up to 1 c.c. He found the intradermal method of administration easier to execute, less uncomfortable and safer than either the intravenous use of typhoid vaccine or the intramuscular injection of boiled milk. His conclusions were that the results were about the same as from the more severe type of "nonspecific shock," and the disturbing reactions less severe. Details are given in this article.

Foreign Protein Treatment

The injection of any foreign protein into the body tends to stimulate the reticulo-endothelial system as an aid to the defence forces. This use of protein is spoken of as "nonspecific" because no particular protein is required. For many years this was used to some extent by the employment of antitoxic serums and bacterin treatment, and it is possible that the foreign protein in the injections was a factor in the results secured. However, the amount in these long-used injections was comparatively small.

Later much larger amounts of foreign protein were injected in the form of milk, with marked beneficial results in many forms of acute inflammation, including pelvic inflammation. The treatment consisted of the intramuscular injection of from 5 to 10 c.c. of sterilized milk. Now there are available special milk preparations put up by manufacturing firms in convenient sterile packages for this purpose, with dosage and directions for that particular preparation in the package.

In addition to the beneficial effects of these "foreign protein" injections, there are certain disadvantages. An important one is hypersensitization, resulting in anaphylactic reaction on second dose with some individuals or allergic reaction on even primary dose with certain allergic persons.

Foreign protein treatment for infections has been largely superseded by chemotherapy with the sulfonamides, which is preferable when it is successful. When, however, it is unsuccessful or contraindicated by developments, foreign protein treatment may be indicated. In an allergic individual or one who has received a previous serum injection recently, it would be preferable to use the plain bacterial vaccine treatment (not serobacterin, which contains serum) of the specific or nonspecific type.

HEMOSTATICS

Hemostatics act principally in two ways—by constricting the uterine wall and blood vessels and by increasing the general coagulability of the blood. There is also a third way in which bleeding may be lessened, namely, by the action of a hormone or other substance in the uterus affecting the local coagulability of the blood or the permeability of the vessel walls. The presence of such a substance may be a factor in the endocrine regulation of the starting and stopping of the normal menstrual flow.

In the first class belong the various ergot preparations and the pituitrin preparations. In the second class come the calcium preparations. Calcium gluconate is one very largely used. Vitamin K has been described. Other general agents for controlling bleeding in gynecologic cases are fibrinogen or thrombogen preparations, put out under various trade names by different firms, pectin, and snake venom.

Pectin preparations have been shown to act together with calcium in reducing clotting time 40 to 50 per cent. Arhemapectin is one such preparation. It may be given orally or intramuscularly or intravenously. Moccasin venom has been used with success in the treatment of functional bleeding. The undesirable sensitization was a drawback, but Peck and Marx have succeeded in separating the antihemorrhagic factor from that causing the sensitization reactions. In hemophilia, Timperley found that egg white incubated at 37° C. for several days in the presence of potassium bromide gave an extract which controlled the bleeding. Styptysate, a preparation from a medicinal plant, has been found helpful in controlling a persistent bleeding tendency in uterine conditions, for which it is administered orally. It may be used also locally for local bleeding.

PLASMA BALANCE

Plasma is a convenient term by which to designate the body fluid which circulates in the blood vessels and fills the intercellular spaces in the tissues. The functioning cells of the various organs work in and live on this vital fluid, which brings necessary supplies and carries away the waste products. The plasma is literally the river of life for the body, which depends on its constant flow and fairly constant quantity and quality. The cellular elements of the blood and tissues largely monopolized attention for a long time, but studies in recent years have shown that variations in the quantity and quality of the plasma have a serious bearing.

Disturbances in the quantity or quality of this fluid are reflected in disturbances of cell activity appreciable by physical examination or laboratory methods. Edema, dehydration, acidosis, alkalosis, and hypoproteinemia are conditions of the plasma of sinister significance to functioning, especially in surgical patients requiring still further drain on the reserve of vitality. The salient facts in regard to the first four have long been known and generally used in the preoperative and postoperative handling of surgical patients, but the facts concerning the fourth need emphasis and wider understanding and use. Elman gives an instructive résumé from which are the following quotations:

Hypoproteinemia.—Under normal conditions the concentration of protein in the plasma is about 7 grams per cent; of this, but a few tenths of a gram are due to fibrinogen. If this is subtracted, as it is when blood is allowed to clot so that serum is obtained instead of plasma, there is little significant change in the total figure. What remains is a combination of the two remaining proteins, namely, albumin and globulin. Under normal conditions the albumin concentration is roughly twice that of the globulin concentration. The relationship between the two is often spoken of as the A/G ratio, a figure which may or may not be of significance. Of much greater importance is the actual concentration of the albumin fraction inasmuch as it is the fall in the albumin fraction which is usually observed in hypoproteinemic states. From the practical point of view, then, we should really speak of hypoalbuminemia rather than hypoproteinemia. Moreover, it is the albumin fraction which is concerned mostly with maintaining osmotic pressure of the blood, and it is the osmotic function of the plasma protein which is mostly involved in the deficiency states just discussed. It is probable that the globulin fraction has more to do with the carrying of immune bodies than with maintaining the osmotic pressure of the blood.

The chemical method used in determining the concentration of serum or plasma protein is extremely important. Variations which are obtained by inaccurate methods may be quite valueless. Errors may occur either in the determination of the protein or in the fractionation of albumin and globulin or in both. Of the two methods for the determination of protein we use and emphatically advise the Kjeldahl procedure in preference to nesslerization in measuring nitrogen. We also use and advise that separation of albumin and globulin be effected with the centrifuge rather than with filter paper. Details can be found in most biochemical texts. The actual fall in serum protein, particularly in the albumin fraction, is often 50 to 75 per cent of the normal. In general a serum protein of below 5 grams per cent or a serum albumin of below 2 grams per cent is considered abnormally low and is often accompanied by nutritional edema.

While there is a definite relationship between the clinical occurrence of nutritional edema and the level of serum albumin, there is a considerable lag in this relationship. There may be rare occasions when the serum albumin is near normal, yet edema exists. On the other hand, the albumin may fall even below 2 grams per cent without demonstrable clinical edema which will, however, inevitably develop if the low serum albumin persists for a sufficiently long period of time. It is, therefore, often misleading to speak of a critical

level of serum albumin. It is important to realize that edema of the interstitial tissue may occur for a long time before it is evident clinically as a swelling which pits on pressure.

A second source of confusion is the relationship of the plasma volume to plasma protein concentration. This is important in evaluating the significance of hypoproteinemia. Actually the plasma volume may vary so much, especially when intravenous fluids are being given, that the concentration of plasma protein must always be considered in relationship to changes in the concentration of the red blood cells which is a rough measure of the variations in relative plasma volume. It is, therefore, of importance to measure the hematocrit or red cell concentration whenever a serum protein or serum protein concentration may be observed in patients receiving fluids due entirely to the dilution of the plasma, which can be very readily followed by frequent determinations of the red blood count or the hematocrit.

Toxic Destruction of Protein.—A second type of protein deficiency which can be measured occurs in many patients in whom there is an abnormal destruction of tissue protein. This is revealed by finding an excessive excretion of nitrogen in the urine. This phenomenon has long been observed in a good many serious illnesses, notably in the infections. It also occurs following extensive trauma and is frequent in seriously ill patients after a serious operation. The important point about this type of protein deficiency is that replacement therapy should take such a loss of nitrogen into account, i.e., administration of protein nourishment is extremely important in any individual who is losing a great amount of nitrogen due to the actual effects of the disease process itself. There are actually very little data in regard to this type of protein derangement in surgical patients. It is probable that further study will reveal that not only does this type of toxic destruction of protein occur rather frequently but that many of the clinical manifestations are due actually to such a phenomenon. Regardless, however, of such further observations it seems apparent that this type of derangement has definite therapeutic implications which must be recognized if we are to use protein replacement therapy.

Surgical Shock.—During the past few years it has become increasingly apparent that plasma loss, i.e., fluid containing 7 per cent protein, is an important feature of the circulatory failure in shock. This is particularly true in severe burns, in the therapy of which plasma in large amounts is decisive, in contrast to the ineffectiveness and even danger of injecting large quantities of saline and glucose alone. It is not too much to say that an acute hypoproteinemia occurs in severe burns, in severe hemorrhage, and probably in other examples of surgical shock. The fall in blood volume in all of these conditions is due to loss of fluid containing protein which must be taken into account if we are to practice true replacement therapy. In other words, the acute protein loss cannot be remedied by the injection of saline and glucose alone; fluids possessing colloids capable of exerting long-lasting osmotic pressure must be used and for this plasma is ideal. While the value of whole blood in surgical shock is generally recognized it is not often realized that the plasma portion is the most significant; in burns in fact the red cells are not even needed. The amount of plasma required may be tremendous; in a severe burn as much as 10 to 20 c.c. per kilogram (700 to 1400 c.c. for an adult) may be necessary to meet the loss and return fluid balance to normal.

Methods of Protein Administration

Oral Administration.—Needless to say the oral method of administering fluids and food should always be used when possible. This seems to be an unnecessary statement. However, there has been so much parenteral injection of fluids in recent years that it seems important to emphasize the fact that the oral method should be used whenever the patient can ingest and assimilate food or fluid in this manner. The oral method is, of course, convenient but there are certain factors which must be observed. In the first place, proteins vary in their biological activity. This is due to the fact that the efficacy of the proteins depends upon their constituent amino-acids, of which 11 are essential or indispensable, i.e., these 11 cannot be synthesized by the body and must be supplied. The biological value of the protein, therefore, depends upon the relative proportions of these 11 amino-acids. It has long been known that certain proteins are very rich in these essential amino-acids and, indeed, contain all of them. These biologically active proteins are

present in eggs, milk and meat with soy beans perhaps to be added. Obviously, if the patient is suffering from an acute or chronic protein deficiency and is having difficulty in ingesting a large amount of food, it should be the duty of the physician to see that the kind of protein given is of a biologically active sort. In this way the protein deficiencies can be met with a relatively small amount of protein. The dose of such proteins is ordinarily given as 1 gram per kilogram per day. This dose may be increased in patients who need protein urgently.

A second factor in the administration of protein by mouth is the possibility that in sick patients digestion is not normal and that even though an adequate protein diet is ingested, digestion and absorption are so impaired that the efficiency of the protein diet is not wholly achieved. Such a situation may develop in hypoproteinemia because nutritional edema of the intestinal mucosa occurs interfering with normal function. Deficient absorption occurs also in various types of pancreatic insufficiency, in diarrhea and in intestinal fistula. When oral alimentation is insufficient for such reasons or is impossible or inadequate for other reasons, protein must be given parenterally.

Transfusion.—One of the earliest methods for the correction of hypoproteinemia was the use of whole blood transfusions. This indeed is true replacement therapy although a more accurate method is the use of plasma alone, particularly if there is no deficiency in the red blood cells. In recent years the use of plasma has become more and more extensive, particularly because it can usually be given without the necessity of typing. Plasma is ideal in acute hypoproteinemia, i.e., in surgical shock and after severe burns, although it should be remembered that large amounts may be required.

In chronic hypoproteinemia, unfortunately, transfusions often correct protein deficiency inadequately, particularly when the deficiency is pronounced and much protein is needed to restore conditions to normal. In such patients it has been found that the administration of one or two or even many transfusions is apt to produce but a transient and very slight increase in the concentration of serum protein. Indeed, in Barnes Hospital recently as much as 1000 c.c. of plasma was injected into a 40 kilogram patient on three successive days with pronounced though transient clinical improvement but without increasing the level of hypoproteinemia, which was about 4 grams per cent. Obviously, in such a case the serum protein or plasma is being utilized for other purposes of the body than in replacing the serum protein. This, indeed, is what one would expect in any patient who is suffering from a severe protein depletion. There are other requirements for protein besides plasma. When these requirements are unsatisfied by the normal channels the blood plasma is drawn upon. Obviously, therefore, the injection of plasma protein serves to supply not only the missing protein in the blood stream but also missing protein throughout the entire body. For example, to supply an average adult with 70 grams of protein per day would require the plasma from about 2500 c.c. of whole blood each day. This is probably the explanation of why transfusions either of whole blood or of plasma are very apt to be disappointing when large amounts of protein are required.

Parenteral Injection of Amino-Acids.—Because of the practical difficulties in giving a sufficient amount of protein in the form of plasma and whole blood in patients in whom the oral method is impossible or ineffective, it occurred to us several years ago that it might be possible to supply the protein needs of the body by means of a mixture of amino-acids injected intravenously. Absorption of amino-acids from the intestinal tract is, indeed, the normal method by which digested protein is assimilated. Internal protein metabolism also occurs by continuous hydrolysis and synthesis, the connecting link being the constituent amino-acids. During the course of the study many problems developed which proved difficult to solve; a short preliminary note was published previously in this Quarterly. The complete solution of these difficulties seems close to realization at the present time. It is now possible to prepare a crystal clear solution containing all of the amino-acids of hydrolyzed casein. This preparation has proved innocuous on intravenous injection; nearly 400 such injections have been given with no untoward reactions. The clinical improvements as well as evidences of protein synthesis and positive nitrogen balance have been definite; details are described elsewhere. It is probable that this particular intravenous preparation will soon become available for general use in patients requiring protein nourishment and unable to take anything by mouth.

ALLERGY TREATMENT

The widespread tendency to allergic reaction must be taken into consideration in seeking the cause for unexpected persistence of a disorder in the genital tract. This applies especially to disturbances of the external genitals and vagina, where contact allergy may be a factor, but it must be considered also in unduly-persisting uterine, tubal, and ovarian disorders. It may be the primary cause, the allergic manifestation localizing in the pelvis because of menstrual congestion or other favoring condition, or it may be simply an associated factor, possibly induced by the products of the primary disease.

Allergy is a term much used with a hazy idea as to meaning and limitations. In fact, the limitations themselves are rather hazy, for a large class of allergic disturbances carries the designation atophy (strange disease), and there are many strange diseases. Custom and classification, however, have brought order into the matter. The term allergy was originally used by Von Pirquet to designate altered capacity of the tissues to react to bacteria and to nonbacterial substances, giving the two divisions of allergy.

From the first division come the various reaction tests to determine the presence in the body of a particular bacterium, and incidentally the probability of its responsibility for a deep lesion present. The second division, reaction to nonbacterial substances, includes the great mass of disorders commonly called allergic. These nonbacterial allergies are divided into classes as shown in the table (which is from the helpful exposition of Allergy by H. L. Alexander in Barr's three-volume work *Modern Medical Therapy in General Practice,* Williams & Wilkins Company). ''Atopy'' is used to designate the heredity class of allergic disturbances, of which the principal representatives are bronchial asthma, hay fever, and infantile eczema. ''Physical'' allergy is that due to heat, cold, light or mechanical irritation.

COMPARATIVE DIFFERENCES BETWEEN MEMBERS OF THE NONBACTERIAL ALLERGY GROUP
(H L. ALEXANDER)

ALLERGIC DISORDER	OCCURRENCE	HEREDITY	AGE OF ONSET	SKIN TESTS	ANTI-BODIES	PRINCIPAL CLINICAL EXPRESSIONS
Atopy	Undetermined percentage affected	Determining factor	Mostly earlier decades	Cutaneous intracutaneous passive transfer	Reagins	Bronchial asthma, hay-fever, vasomotor rhinitis, infantile eczema, gastrointestinal disturbances
Contact dermatitis	All humans probably susceptible	No influence	Any age. More frequently in adults	Patch test	None	Eczematoid lesions limited initially to sites of contact
Physical allergy	Small number affected	No influence	Mostly earlier decades	None	None	Urticaria, low blood pressure, syncope, increased gastric acidity
Drug allergy	Small number affected	None in most cases. Some are atopic	Any time of life	Rare	None	Cutaneous and visceral symptoms of atopy. Also fever, lymphadenitis
Serum allergy	Large number affected	None excepting in special instances	Any time of life	Positive to serum after 1st injection in most cases	Precipitins	Urticaria, fever, arthralgia, lymphadenitis, asthma, collapse, death

In a series of 32,000 tests (the number for a particular substance varied from about 300 to 5,000), the following percentages of positive reactions were obtained. Contact substances (contact by inhalation or otherwise): **feathers, 20 per cent; orris root, 16 per cent; pyrethrum, 9 per cent; horse dander, 16**

per cent; cat, 9 per cent; cattle, 8 per cent; dog, 8 per cent; wool, 11 per cent. Foods: wheat, 22 per cent; barley, 10 per cent; rye, 8 per cent; oats, 6 per cent; corn, 5 per cent; rice, 5 per cent; spinach, 13 per cent; beans, 12 per cent; potato, 12 per cent; tomato, 11 per cent; carrot, 11 per cent; peas, 11 per cent; egg, 18 per cent; milk, 14 per cent; chocolate, 13 per cent; pork, 8 per cent; beef, 7 per cent. This is only a partial list of the many substances to be considered, but it shows the percentage of definite reactions to many common contact and food articles. In persistent irritation about the external genitals, clothing materials must be considered and rayon, now used so much, must be added to the wool and silk.

This hasty glance at allergy should call attention to it in connection with gynecologic disorders and lead to investigation in that direction in troublesome conditions which persist without evident cause. The present knowledge of the various ramifications of the subject is most helpfully summarized in the exposition previously referred to.

There have been cases reported in which the patient had cyclic asthmatic attacks because she was sensitive to her own menstrual blood. Desensitization with blood drawn during the menses resulted in cure.

THERMOTHERAPY

Thermotherapy includes fever therapy and refrigeration therapy. Fever is one of the defensive mechanisms of the body. Raising the body temperature has been found to lessen the vitality of invading organisms and to increase the body resistance to their poisons.

Refrigeration lowers the activity and vitality of cells. Cancer cells will succumb to injury that the surrounding normal tissue cells may recover from. Based on this principle of greater vulnerability is the selective killing of cancer cells by radium, x-ray, and other forms of destructive energy, and it was hoped that refrigeration also might prove valuable in this direction.

Fever Therapy

Formerly induced inefficiently by hot water or steam or dangerously by inoculation with some fever-producing organism, it is now brought about and regulated by special apparatus which, though complicated, is well controlled and safe under trained management.

Fever therapy is being used in many types of infection with varying results. In gynecology its chief use is in gonococcal inflammations which do not respond to treatment with the sulfonamides. In certain cases of brucellosis, in pelvis and elsewhere, the results have been outstanding. Alone or in combination with other measures it promises help in many resistant disorders. Combination of fever therapy with sulfonamide therapy or with Elliott local heat treatment has proved helpful in refractory cases. This type of treatment requires particular management, with specially trained attendants and careful selection of cases by a physician familiar with the indications and contraindications.

Bromberg gave an excellent review of the subject in reporting the results in 290 cases with 1,300 treatments in the fever therapy department of Barnes Hospital, and the following items and quotations are from his article.

In 24 cases of gonococcal inflammation (other than arthritis) in women (salpingitis, metritis, cervicitis), 83 per cent were cured, 12.4 per cent improved, and one (4.6 per cent) not improved. ''In the average case in this gonococcal series a total of twenty-one hours of fever was necessary to effect a cure. Of this amount sixteen hours were at 106° F. plus, and five hours at from 104° to 106° F. As a rule the chronic cases required less fever than the acute cases. Our criteria of cure were the same as those outlined by Owens and Desjardins et al.''

In 40 cases of gonococcal arthritis, 80 per cent were cured, 17.5 per cent improved, and one case (2.5 per cent) not improved. ''The one patient who was unimproved after fever therapy was considered by some consultants to be suffering from a type of nongonococcal arthritis. 'Improved' means eradication of the focus of infection and complete freedom from symptoms but some residual limitation of joint motion from the disease. In four of the seven patients in this category, ankylosis of the affected joint was present before fever therapy.''

''Conclusions: 1. Artificial fever therapy is of established benefit in gonococcal infections. It is particularly useful in complicated gonococcal infections or in those patients who have failed to improve under a more conservative regimen such as sulfanilamide and local treatment.

''2. Artificial fever is a useful adjunct to chemotherapy in the treatment of neuro syphilis and has the advantage of controllability and safety when compared to malaria and other infectious thermogenic agents.

''3. Fever therapy is probably the best available treatment for Sydenham's chorea.

''4. This therapeutic procedure gives promise of real benefit in the treatment of brucellosis, rheumatic fever, certain inflammatory eye conditions and in other disease states which have been known to respond favorably to nonspecific protein therapy in the past.

''5. Artificial fever therapy has inherent dangers and should be strictly an institutional procedure in the hands of expert personnel.

''6. The results achieved in the treatment of 290 patients at Barnes Hospital are reported and analyzed under separate disease headings. There have been no fatalities.''

Refrigeration

General refrigeration or crymotherapy or ''hibernation'' with cold has been experimented with extensively, particularly in patients with cancer which is advancing in spite of other measures. It was used with the hope of checking the cancer or of relieving the pain and distress more satisfactorily than with other methods of treatment. Though there has been much enthusiastic writing about it, perusal of the literature and personal reports from competent observers, who visited the headquarters of the work and hopefully watched patients under treatment, are not encouraging as to any substantial results and raise apprehensions of definite injury.

It was thought that local refrigeration might bring about benefits without the dangers of general refrigeration. Gordon and Cresci gave local refrigeration a careful trial in ten cases of advanced genital cancer, with the idea of going on to general refrigeration if the results justified it. Their summary follows:

Ten patients with advanced genital cancer, nine cases of carcinoma of the cervix, and one case of carcinoma of the vulva received local refrigeration therapy. In six cases the duration of therapy was 96 to 900 hours. Temperature was maintained between 40° F. and 50° F. in one case, at 50° F. in three cases, at 50° F. to 55° F. in two cases, and 60° F. in one case. Control of temperature was satisfactory.

Notable diminution in size of the tumor mass was observed in three cases, and pain was relieved in two cases.

Serial biopsies showed cellular degenerative changes in only one case. Marked necrosis of the cancerous refrigerated area was found at necropsy in three cases, in two of which fistulas were present with complete destruction of the ureter. Death occurred in coma in four cases, and it is our opinion that death was hastened by local refrigeration therapy.

NEUROTHERAPY AND PSYCHOTHERAPY

Treatment for pain occupies a large place in the various fields of practice including gynecology. It involves the study of nerve and cerebral sedatives of the different types. In terminal cancer cases especially, the resources of the neurologist and the neuro-surgeon may be needed to assist in giving relief.

The nerves convey the impulses from the various parts of the body and the mind interprets those impulses. These interpretations determine the patient's actions and outlook. They also form the symptoms which she relates to the physician. There may be trouble in the lines of communication or in the central office of interpretation, which exaggerates or modifies or interprets as terminal something that is remote from the genital tract nerve terminals.

Many nervous patients with gynecologic symptoms need the careful neurologic and psychiatric investigation and treatment which the competent neurologist can give. Psychotherapy has been critically investigated and sympathetically studied in recent years by reliable physiologists and clinicians, and methods of treatment have been worked out which, in conjunction with necessary medication or operative measures, will greatly hasten the cure in many cases, and will restore to health some patients otherwise incurable.

In these cases there are, of course, symptoms not accounted for by the gynecologic lesion, nor by lesions found elsewhere. Pain or paresthesia persisting or recurring without apparent reason should arouse suspicion that it may be of mental or psychic origin and requires treatment accordingly. Neurologic investigation and advice may be helpful also in many nervous, depressed individuals, with trying domestic problems that overtax their nervous stability.

LOCAL MEASURES

For a glance over our resources, it is well to divide the large array of local measures into groups according to effects, as follows: cleansing (douches, applications), pH regulating, antiseptic, hemostatic, hygroscopic, anesthetic and antipruritic, growth promoting, supporting (pessaries, tampons, packings), cauterization and coagulation and excision, dilating, stretching (pressure treatment, massage), postural exercises, local heat (hot douches, circulating hot water, circulating hot air, diathermy), local cold (ice bag, circulating cold water), radiation (radium, x-ray), operations.

Cleansing

The simplest form of local treatment is the removing of irritating material. This is accomplished at home with the vaginal douche, and at the office by cleansing with cotton balls either dry or moistened with some solution, usually a mild antiseptic solution. In the trichomonas vaginitis cases, some prefer a solution of soap (sapo virdis).

The vaginal douche apparatus is preferably of the gravity type, consisting of a two-quart container (rubber bag or metal can) with rubber tubing and a hard rubber douche nozzle. The bulb type of apparatus is not so effective, even though accompanied with attractive spray drawings. The principle of the gravity douche and also the general arrangements for it are indicated in Fig. 326. The douche bag is hung three or four feet above the level of the surface on which the patient lies, and the hips are elevated slightly so that the solution will flow to the top of the vagina. Usually the most convenient arrangement is for the

Fig. 326.—Patient arranged for the long hot vaginal douche. Notice that the patient's hips are elevated and that the douche pan has an outlet tube leading into a bucket beside the bed. The douche nozzle has a thick end and the openings are at the side, so that there is no possibility of the water being forced into the uterine cavity. The douche bag may be hung at any height required to give the desired rate of flow

patient to lie in the bathtub with a folded towel under the hips. If the patient is too ill or otherwise incapacitated for getting in and out of the bathtub, a douche-pan may be used on the bed as shown in Fig. 326, with rubber sheeting or oilcloth for protection, tubing to conduct the solution from the douche-pan to a bucket beside the bed if a large douche is to be used, and a wide board to be slipped under the mattress to prevent undue sagging.

The douche bag and tubing and nozzle are scalded out by running hot water through them, and then wrapped to protect from dust. Ordinarily the

douche consists of hot water from the faucet, cooled to comfort with cold water and then the special solution or powder added and mixed well.

Vaginal douches should be used only when there is some definite indication for them. They are not required for mere cleanliness; in fact, they may interfere somewhat with normal physiology and the germicidal vaginal contents which tend to keep the vagina in healthy condition.

The simple cleansing douche may be used when there is a troublesome increase in the normal muco-epithelial secretion or when there is some muco-purulent discharge not requiring a special douche. The water should be just comfortably warm, and the addition of salt (sodium chloride), teaspoonful to the quart, is preferable to the use of plain water. A mild douche of pleasant odor may be made by adding a teaspoonful of compound zinc sulphate powder (Pulv. Zinc. Sulf. Co., N.F.) to two quarts of warm water. This contains the principal ingredients used generally in the numerous advertised proprietary douche preparations with attractive names and fancy prices.

pH Regulating

The acidity of the normal vaginal contents is around pH 4, and any marked tendency toward alkalinity favors the growth of pathogenic organisms and the consequent development of vaginitis. As explained and illustrated in the previous chapter under pH determinations, this has been so well worked out that it is known which organisms flourish at different stages of pH increase (Fig. 250) and, vice versa, one can judge about what the pH is by the type of discharge and organisms found.

An important factor in the cure of vaginitis is the restoration of normal pH of the vaginal contents. This is accomplished by acid douches and the use between douches of powders or tablets containing a carbohydrate to be converted into acid, to encourage the growth of the Döderlein bacillus which normally makes the conversion. For acid douche use one-half to one teaspoonful of lactic acid (U.S.P.) in two quarts of warm water or three tablespoonfuls of a good grade of white vinegar to two quarts of water. The following is the prescription with directions for the lactic acid douche.

R   Lactic Acid, U.S.P.   1 lb.
   Sig.: For local use only. One-half to one teaspoonful to two quarts of warm
       water. Use as directed.

Acidifying powders consist of glucose or B-lactose with starch and boric acid in various proportions. The powder is blown into the vagina or packed in at the office treatments, and for home use it is put in capsules for introduction into the vagina by the patient. Acidifying tablets are supplied by drug manufacturers, usually with the addition of a mild antiseptic agent to assist in the elimination of the pathogenic organisms. These powders and tablets are used in the treatment of the various forms of vaginitis, the details of which are given in the next chapter.

Antiseptic

The antiseptic douche is used in those cases of purulent discharge or muco-purulent discharge in which the admixture of pus is so prominent that an active

germicidal effect is important. A very satisfactory antiseptic douche is made by adding a teaspoonful of lysol to two quarts of warm water. In some cases a potassium permanganate douche (1:5,000 solution) is more satisfactory.

Mercury bichloride was formerly often prescribed for an antiseptic douche. But the concentrated solution for making the douche is dangerous when remaining in the medicine cupboard of the home. So many fatal cases of accidental poisoning from bichloride solution or tablets have occurred that it is not advisable to prescribe the drug for home use.

As to antiseptic solutions for office application, the following have some antiseptic effect: silver nitrate (1 to 10 per cent), protargol (2 to 10 per cent), argyrol (10 to 20 per cent), mercurochrome (1 to 10 per cent), tincture of iodine diluted to half strength for disinfecting surfaces. The silver preparations, particularly argyrol, tend to lessen the hypersensitiveness of inflamed surfaces and diminish the discomfort. The tincture of iodine (diluted) may be used for sterilizing the cervical canal and the sound-ends for dilating.

As a drying and mildly antiseptic powder boric acid and kaolin, equal parts, may be used. Another such powder is xeroform (bismuth tribromphenate) and boric acid (1 to 4). Xeroform has proved a very satisfactory substitute for iodoform. Its action in stimulating healthy granulation is similar to that of iodoform, and it has practically no odor. It is about as effective as other iodoform substitutes and less expensive.

Hemostatic

The following have local hemostatic effects: copper sulphate (10 per cent solution), adrenalin (1:1,000 solution), and styptysate liquid. The copper sulphate solution is used as an astringent on eroded areas. Adrenalin is used to check bleeding at some spot, for example, where a polyp or specimen has been removed. The end of a tampon is moistened with a few drops of the adrenalin solution and placed against the bleeding spot, and left until the next day. Styptysate liquid may be used in the same way. It comes in 10 c.c. bottles for local use. Tannic acid added to the xeroform and boric acid powder (1-1-4) makes a convenient astringent powder. An astringent powder is likely to be uncomfortable on an inflamed or irritated surface.

Hygroscopic

Glycerin, either plain glycerin or boroglycerin (boric acid 50 per cent) is used for its hydroscopic (water-extracting) effect. Special drugs may be incorporated in the glycerin for special effect. The application is made by soaking one end of a tampon in the desired glycerin preparation and then introducing it through the speculum into the upper part of the vagina, the medicated end being placed against the cervix. These glycerin tampons are used particularly in acute and chronic inflammatory conditions in the pelvis. They seem to assist materially in diminishing the pain and soreness and they certainly exercise a decided effect on the adjacent tissue fluids, for the patients often remark on the large amount of water which comes from the vagina when using these glycerin tampons.

Formerly ichthyol-glycerin was used on tampons a great deal and for long periods, but there is now doubt as to the advisability of this use, for it has been shown that in susceptible animals prolonged application of coal tar preparations favors cancer development.

Anesthetic and Antipruritic

For surface anesthetization, cocaine solution (10 to 20 per cent) may be used, applied on cotton and left for five minutes. Novocain solution ($\frac{1}{4}$ to $\frac{1}{2}$ per cent) sterilized is used for subcutaneous or submucous injection for removing small growths or pieces of tissue for microscopic examination. A powder may be made somewhat anesthetic by adding orthoform, for example, orthoform added to the xeroform and boric acid powder (1-1-4), or chloretone (chlorbutanol) may be added instead of orthoform in the same proportion. Various special anesthetic preparations are put out by manufacturers, such as nupercaine ointment and diothane ointment.

Antipruritic agents are used principally in pruritus vulvae and are taken up in detail under that disorder.

Growth Promoting

Estrogens applied locally in the vagina stimulate the epithelium to full growth. Hence such application is indicated in vaginitis in individuals where the protective epithelium is thinned, as in children before puberty and in the atrophic conditions after the menopause. Thinness of epithelial covering opens the way to infection, which is likely to persist until a good protective epithelial covering is restored. For this purpose vaginal suppositories are principally used, the manufacturers putting up estrogenic suppositories convenient for home use. Some of the desired local epithelial rebuilding may be secured by estrogens hypodermically, but the suppository treatment has been found to be better.

Supporting

Pessaries, packings, and tampons come in this category.

Pessaries are appliances introduced into the vagina for the purpose of holding the uterus or vaginal wall in proper position. They are made of hard rubber or soft rubber, usually the former. Those made of soft rubber are generally hollow and contain air or flexible wire. Occasionally a pessary is made of glass or block tin or some other material. With the development of plastics, pessaries may be secured in translucent plastic material.

Supporting pessaries are used principally for retrodisplacement of the uterus and for prolapse of the uterus, and hence will be considered in detail under those subjects. The uterine stem, frequently referred to also as stem pessary, is simply a cervical plug for keeping the canal well open over a considerable period of time. It is used principally in the treatment of obstructive dysmenorrhea, and is considered in detail under that subject. It may be used, also, after amputation of the cervix or excision of the cystic area, to insure preservation of a good wide canal.

Gauze packings are used principally after vaginal operations, to check oozing by pressure and to give support for a short time. Cotton tampons may be

employed in the same way, but they are used most in office treatment, to hold medicine in position at the vaginal vault or to keep inflamed surfaces separated. A vaginal tampon is simply a piece of absorbent cotton or common cotton or wool or gauze, of the desired size and shape, with a short loop of string by which it may be removed from the vagina by the patient after a specified time. Details are shown in Fig. 327.

Ordinarily, all tampons are introduced by the physician. When, however, it is advisable that tampons be applied at home by the patient, between the office visits or in conditions in which the patient cannot well come to the office,
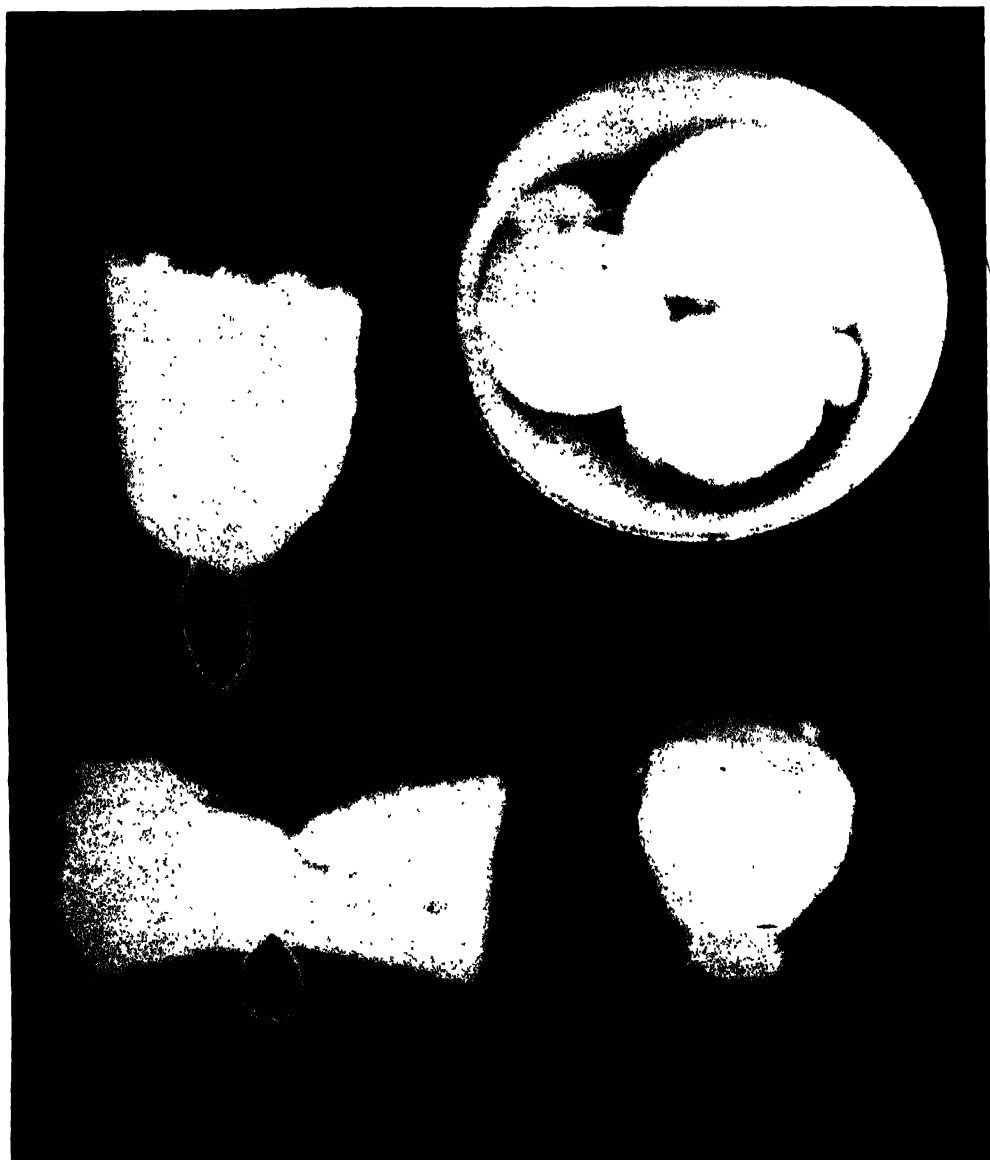
Fig. 327.—Preparation of tampons. a. A piece of cotton of the required size with a strong string tied about the middle and also a loop tied. b. The same, with the ends folded up preparatory to receiving powder in the hollow formed there or to being dipped into an application-solution. c. Another satisfactory way of making a tampon. The piece of cotton is folded and the ends are tied together and the string looped. d. A small bowl containing tampons ready for use.

the tampon-capsule may be employed. It is introduced after the warm douche for hygroscopic effect in acute or subacute pelvic inflammation. Boroglyceride or 5 per cent ichthyol in glycerin is commonly used, and the patient puts the medicine in the capsule, as indicated in Fig. 328, just before introducing the capsule into the vagina.

Specially prepared tampons for absorbing the menstrual flow are sold and are used by many, with or without the usual outside pad as desired. They are particularly useful when the flow is very free or the individual has special activities (acrobat, dancer) or circumstances make frequent changes of pad inconvenient. Thorton presents an instructive study of 110 individuals using menstrual tampons and examined at regular intervals, and concludes that no harm results.

Fig. 328.—Tampon capsules. *a.* Large size. *b.* Small size. *c.* The cap removed, showing the tampon. *d.* A tampon capsule prepared, ready for introduction. The cap was removed and the medicine poured into the cap, which was then replaced.

Cauterization, Coagulation, Electric Excision

In gynecologic work, the ordinary small electric cautery, with thin points similar to those used in nose work, is used principally for linear cauterization of the cervix. The large short wave or high frequency machine is used with the cutting current for conization of the cervix with the cutting wire or radio knife, or with the coagulating current for coagulation or for hemostasis by touching bleeding points. These methods are considered in detail under Cervicitis in Chapter VII.

Dilating

Dilating is required in cases of stenosis of the vagina and of the cervical canal. In either location the stenosis may be congenital or may be acquired from severe inflammation in childhood or later. In the vagina, stenosis inter-

feres with coitus and may interfere with vaginal drainage to an extent to prolong vaginitis. In some cases the narrowing may be overcome gradually by dilating treatments, with fingers or speculum or large vaginal dilators of hard rubber or plastic or metal. Glass dilators have been used, but there is danger of breakage and injury. Where the condition is marked or unyielding operative division of the obstructing tissue is required, with special suturing to preserve the space gained.

In stenosis of the cervical canal, dilation in the office may overcome the trouble in the milder cases. But if the stenosis is marked or attempts at dilation painful, operative dilation in the hospital under anesthesia is advisable.

Stretching

Stretching of tissue is required principally in adherent retrodisplacement which has become a factor in sterility or is causing trouble otherwise. There are two measures which may be employed in attempting to bring forward a corpus uteri held back by thin adhesions, namely, pressure treatment and massage.

Pressure treatment is applied by means of mercury distending a colpeurynter which has been introduced into the vagina, the hips having been elevated properly to direct the pressure. It is used principally in adherent retrodisplacement of the uterus, and the details concerning it are given under that subject.

Pelvic massage had wider application before the development of the more effective means of influencing pelvic circulation and exudates. Now the application is principally to stretch adhesions for mobilization of the uterus to permit lifting it from a troublesome malposition. The movements are largely those of deep bimanual examination and attempts to lift the retrodisplaced fundus uteri and stretch the tissue holding it. Sometimes a kneading of the shortened infiltrated tissue, between the vaginal and abdominal finger tips, will aid in the softening and stretching process.

Postural Methods and Exercise

Knee-Chest Posture

The patient supports herself on the knees and chest (Fig. 329). The head rests on a pillow, with the face turned to one side, and the breasts are brought as closely as possible against the table or bed. To take the correct posture and thus secure the desired effects, particular attention must be given to three details as follows:

a. The clothing must be well loosened about the abdomen—hence the best times to take this postural exercise at home are in the evening just after going to bed, and in the morning just before rising.

b. The thighs should be perpendicular, as shown in Fig. 329, so as to raise the hips as high as possible. Unless particular attention is paid to this point the thighs are likely to slant backward (Fig. 330) or forward, and part of the desired elevation is missed.

c. The back should be curved downward and elbows gotten out of the way so that the breasts come against the bed (Fig. 329). This is to bring the chest as low as possible and give a steep inclination to the peritoneal cavity, so that

the pelvic contents will gravitate toward the abdomen. Fig. 331 shows a common error in this respect, the chest being still too high.

The effect of the knee-chest posture is to take temporarily all downward pressure off the pelvic organs and permit them to gravitate toward the abdominal cavity (Fig. 329). The downward pressure on the pelvic organs is for the time being relieved, the local circulation is improved and a movable retrodisplaced fundus uteri tends to gravitate forward toward the normal position. The effect is much increased if the vagina be opened with the fingers so that air may enter. The position may be maintained from one to ten minutes; ordinarily the patient is directed to take the posture for one or two minutes
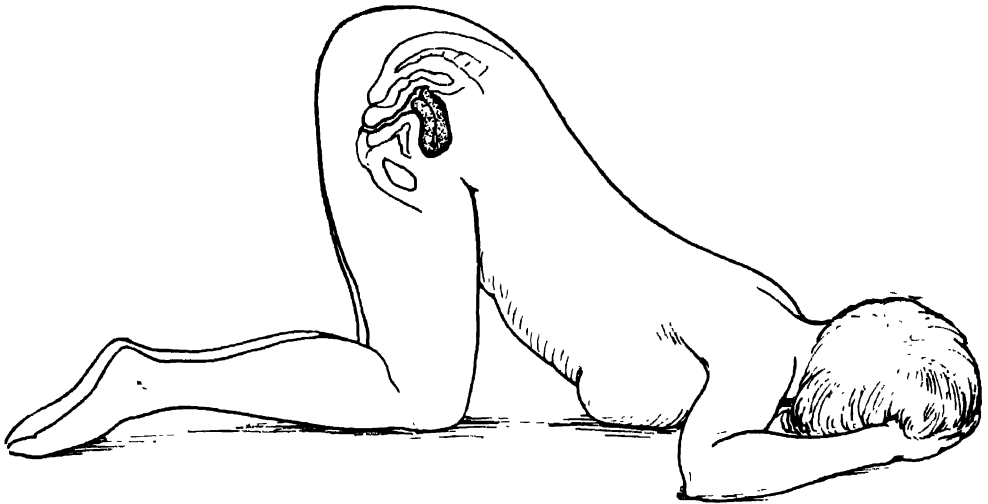
Fig. 329.—The knee-chest posture, showing the pelvic structures in outline and the tendency of the uterus to gravitate forward.
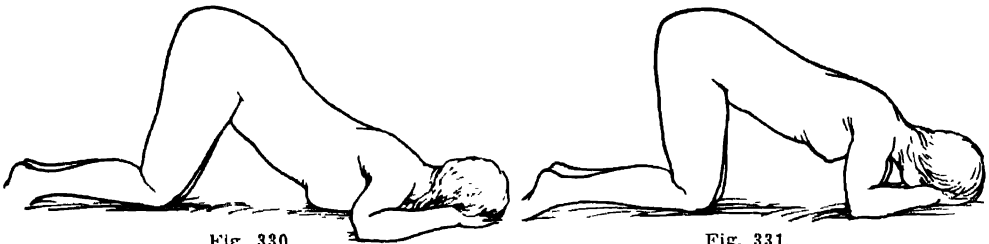
Fig 330.   Fig. 331.

Fig. 330.—Incorrect knee-chest posture. The knees are too far back.
Fig. 331.—Incorrect knee-chest posture. The chest is not brought down to the bed.

twice daily. The knee-chest posture is used by the patient at home in certain cases to supplement other measures when they are not effective alone. Used for two or three months after labor, this is exceedingly useful in preventing retrodisplacement of the uterus.

Monkey Trot

With the feet flat on the floor and about three feet apart the patient bends over, keeping the knees straight, and places her hands on the floor with the palms flat. The patient now walks about on her hands and feet, keeping the knees stiff, for three minutes. The jarring which attends this exercise helps to

make the uterus gravitate forward. The monkey trot exercise gives an exaggerated knee-chest posture effect, and may be used in the same types of cases.

CONTRACTION OF ABDOMINAL MUSCLES

Voluntary systematic exercise of the abdominal muscles is a useful and simple procedure which is very helpful to certain gynecologic patients. It is one of the most effective measures that can be employed in the treatment of that affection which is so distressing to many women, namely, prominence of the abdomen from relaxation of the wall. This is seen principally following confinement, the abdominal muscles, overstretched from the pregnancy, having never regained their tone. The strengthening of the abdominal wall gives
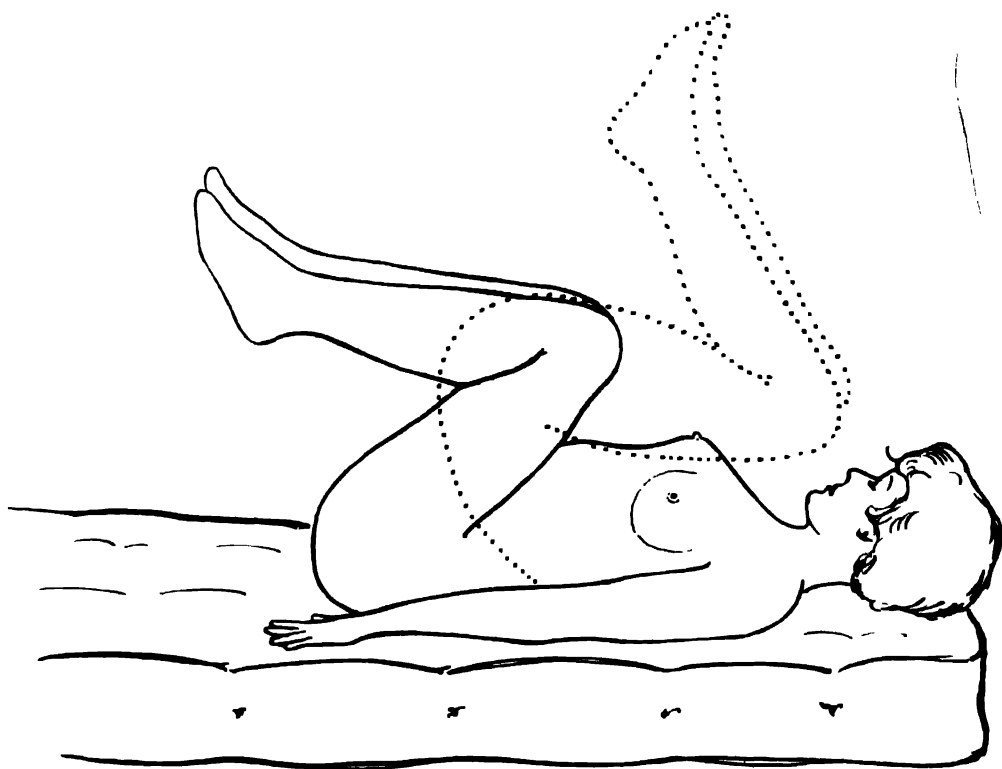
Fig. 332.—Knee to chin exercise to strengthen and shorten the abdominal muscles.

better support to all the abdominal organs and is beneficial in enteroptosis, chronic constipation, and other conditions influenced by loss of abdominal wall support.

The weakness of the abdominal wall is due to weak, stretched muscles, and the purpose of the exercise is to shorten and strengthen these muscles. The patient lies flat on her back in bed with the thighs flexed on the abdomen and the knees bent (Fig. 332). This is the starting position. The exercise consists in pushing forward and downward with the chin and upward with the knees, attempting to touch the knees with the chin. This exercise contracts the recti and at the same time, by tilting the pelvis upward, decreases the distance between the origin and insertion of the muscles. In this way the muscles are shortened

and strengthened. This exercise should be done five or six times to start with, and gradually increased to twenty times with each exercise period.

There is another exercise which helps to strengthen the abdominal muscles. This consists in having the patient raise her head and shoulders from the recumbent position to the half sitting position (Fig. 333). The arms should be folded over the chest. The object is not to raise to the full sitting position, but simply to exercise the abdominal muscles by raising the head and shoulders a moderate distance and holding them there. The movements are most effective when made *slowly*, so as to get long contraction of the muscles.
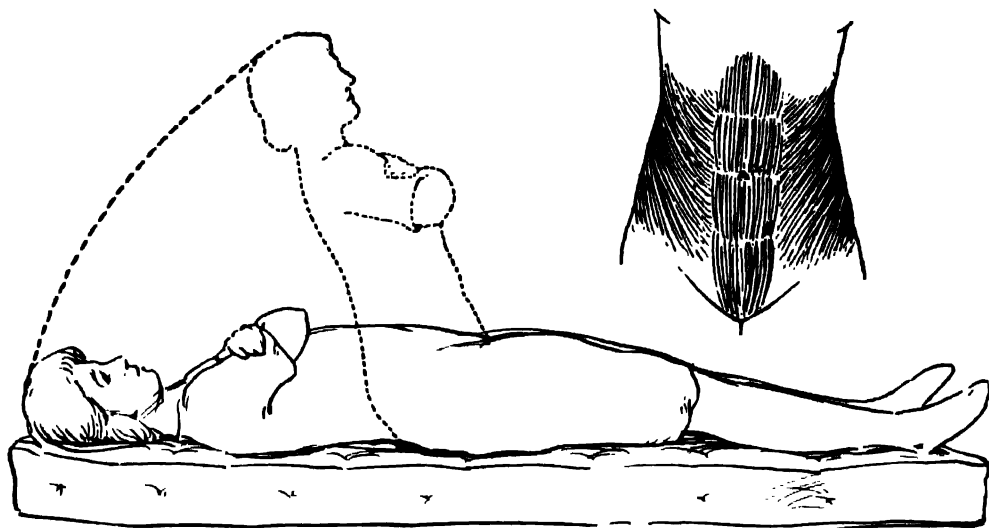
Fig. 333.—The "raising exercise" to strengthen the abdominal muscles. The central abdominal muscles are exercised by raising straight up and the lateral muscles by raising laterally.

Local Heat

Heat to the pelvic organs may be applied in several different ways, the indications varying with the location of the trouble and its nature and severity. Moist heat may be applied by means of hot douches or sitz baths, or by the time-honored hot stupes or the less troublesome hot pastes. Dry heat may be supplied by the hot-water bag or by the more convenient electric heating pad or by the infrared lamp. Higher degrees of heat, with the required regulation, may be administered with the hot-air chamber or by the circulation of hot water or air through a vaginal bag, or by the use of diathermy.

LONG HOT DOUCHE

When it is desired to obtain heat effects from the vaginal douche, attention must be given to certain special points, as follows:

a. The patient should be lying down, with hips elevated so that the water will run well up about the cervix and vaginal vault.

b. The water should be as hot as the patient can take comfortably. Starting with warm water, hotter water is added as the tissues become accustomed to the heat, but it should not be so hot as to cause discomfort.

c. The douche should be of long duration (twenty to thirty minutes). This prolongation of the douche is secured by using a large amount of water (two to four gallons) and giving it slowly, just fast enough to prevent cooling of the water; or the bag can be hung on the hot-water faucet or connections made with both faucets for mixing as desired.

d. The patient should rest in bed for at least an hour afterward, a very good plan being to take the douche at bedtime.

Electric Heating Pad

This is sometimes designated as an "electrotherm." It is heated by a current through a cord, which is attached in the ordinary light socket. This is very useful in applying heat for long periods, which may do much toward relieving the patient's discomfort. Care should be taken to keep the electric pad dry, or a short circuit may occur. Also, the patient should be watched until it is seen that she stands the heat well and that the pad is working satisfactorily.

Infrared Lamp

In recent years the infrared lamp has been used as a source of heat in the treatment of pelvic inflammations. The lamp should be adjusted so that it is about three feet above the abdomen and focused so that most of the rays are concentrated on the lower abdomen. It is doubtful whether the infrared rays themselves have any special beneficial effect, but the advantage from the heat created is evident.

The lamp should not be used for long periods; fifteen minutes, two or three times a day, should give the desired clinical results, and longer periods are enervating to the patient.

The infrared light is localized in its effect and has the advantage that it can be directed on a small painful area. It is useful especially in neuritis or arthritis (sacroiliac, lumbar), in which conditions it often gives much relief. It may also be used over a moist application on the abdomen in order to keep the application warm.

Hot-Air Chamber (Electric or Lamp-Heated)

The most effective application to the lower abdomen for the systematic application of dry heat is the *hot-air* chamber. This method, long used in other parts of the body in the treatment of chronic inflammation, has proved helpful also in like lesions in the pelvis. Various forms of apparatus are available for the purpose. Gellhorn devised a convenient one for use where electricity is available and gave a résumé of the subject. This convenient "abdominal baker" (Fig. 334) is used a great deal about the hospital in the care of gynecologic patients, for pelvic and other painful abdominal conditions.

Circulating Hot Water in Vaginal Bag

The supplying of heat to the pelvic tissues by the circulation of hot water through a vaginal bag, with apparatus for maintaining high temperature and automatically regulating it, was developed by C. R. Elliott, and later experiences reported on by Holden and Gurnee, and also by Counseller. An impor-
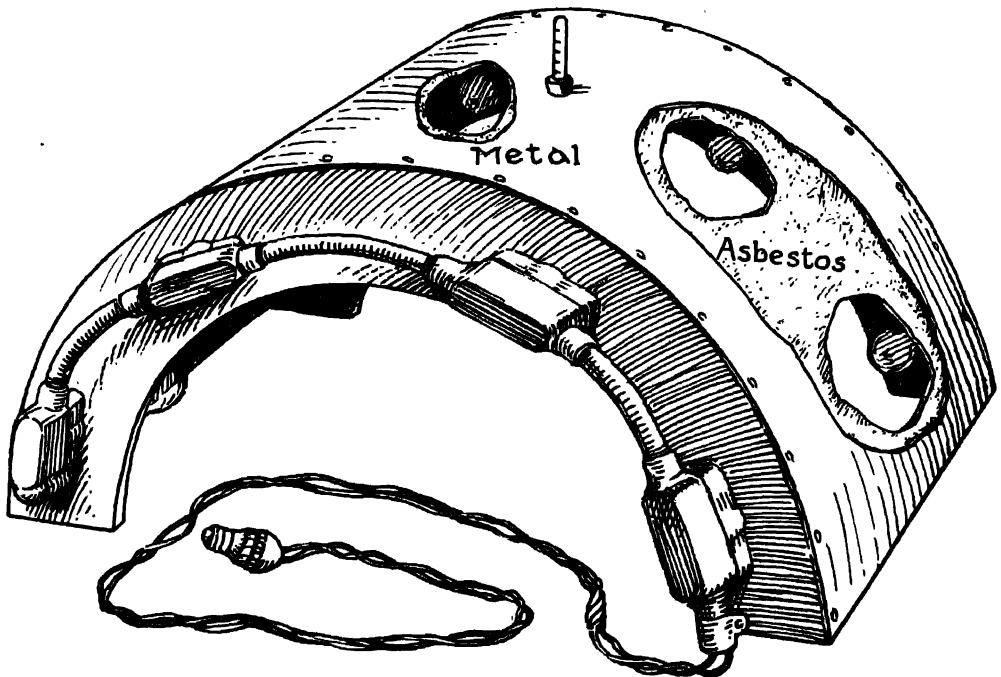
Fig. 334.—Apparatus for dry heat treatment. It may be connected to the ordinary socket on any light circuit. There are eight electric lights. The lights used may be varied in size and number as desired. The metal case, with heavy asbestos lining and the careful covering of all wires, permits the bed clothing to be laid over this apparatus without danger. (Gellhorn—*Am. J. Obst. and Gynec.*)
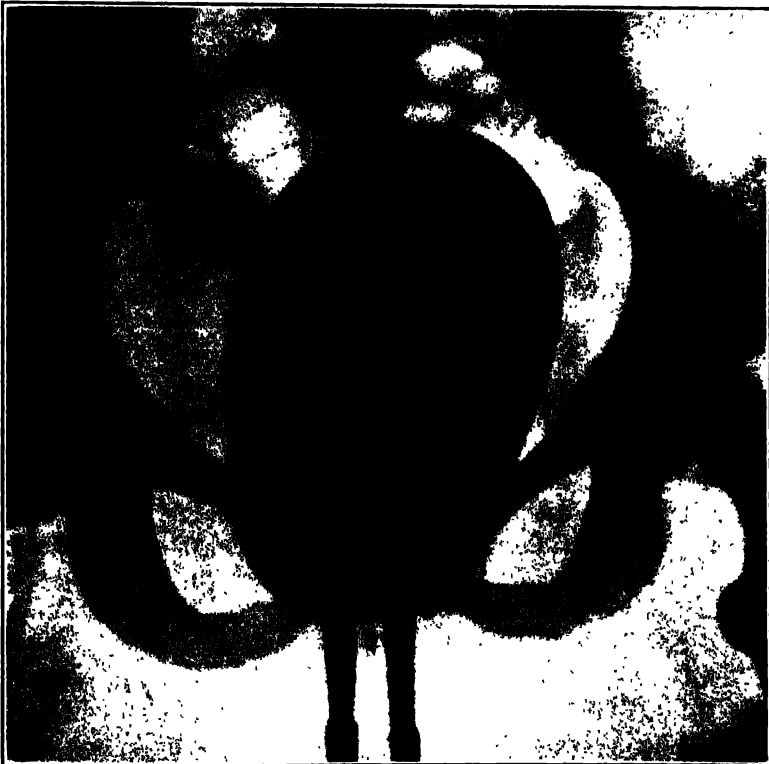
Fig. 335.—Showing distended bag in position in vagina, with the inlet and outlet tubes for the circulating hot water. (Holden and Gurnee—*Am. J. Obst. and Gynec.*)

tant feature is the distention of the vagina, bringing the heat close to the deeper tissues. This marked distention of the rubber bag in the vagina is shown in Fig. 335. This method of treatment, like other forms of heat application, is used principally in pelvic inflammatory conditions and in neuralgia and neuritis.

The Elliott treatment requires expensive apparatus and specially trained assistants for its safe and effective use. All this is fully justified if it gives the patient benefits which cannot be secured by simpler and safer measures. Whether or not it accomplishes this is doubtful. Reports are conflicting, and Cosgrove and Waters have reported severe burns and sloughing from its use.
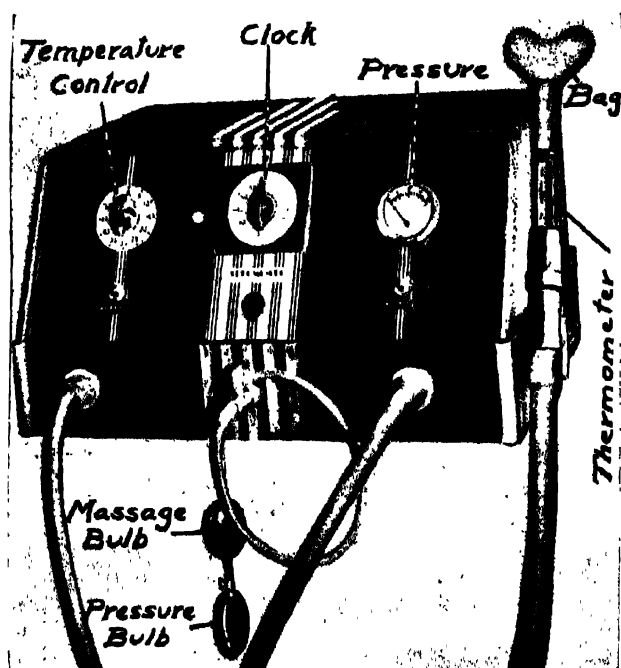
Fig. 336.—Apparatus for pelvic heat treatment by circulating superheated air in a rubber bag in the vagina. Provision is made for even distention of the vagina and for a large measure of automatic control of the treatment. (Falls, Newman and Kobak—*Arch. Phys. Therapy.*)

CIRCULATING HOT AIR IN VAGINAL BAG

Falls, Newman and Kobak report experience with the pelvic application of heat by means of an apparatus for circulation of hot air inside a bag in the vagina. The apparatus, shown in Fig. 336, is arranged for thermostatic control, and it is claimed that the danger of overheating and vaginal-wall damage is eliminated. Full details are given in the article (see Reference List).

DIATHERMY

There are three methods used in giving diathermy treatment with high frequency current. The first is the so-called ordinary diathermy in which the vibration rate is only six hundred thousand (600,000) to one million per second. With this type of diathermy two metal electrodes are used in contact with the skin. The second type is the high frequency alternating electric field. With

this type as well as with the third type the vibratory rate is twelve and one-half to thirty million per second. With short wave therapy, metallic applicator pads insulated with rubber are used on the patient's skin instead of placing the metal plate directly against the skin. The heat is created in the intervening tissue structures through the molecular activities created the same as with the ordinary diathermy type. The other type of short wave therapy is given with the high frequency electromagnetic field. With this method the current is sent through a so-called induction cable applicator. With the cable, heating is effected not by the current passing through the body, but rather by the flow of secondary current induced in the body as the current flows in the coiled-up cable near or on the mass of tissue being treated. Any of these methods can be used in gynecology.
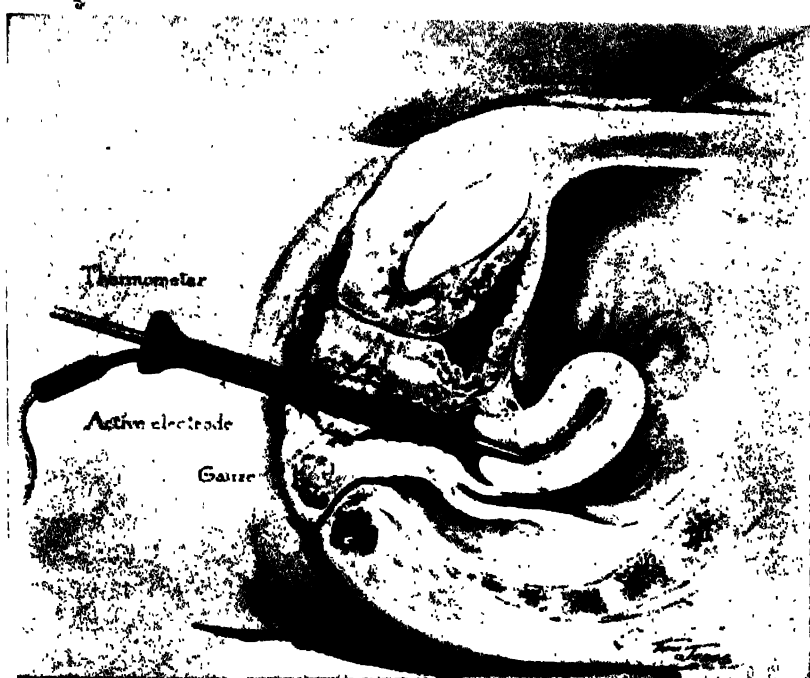
Fig. 337.—The Corbus active electrode or thermophore for use in the cervix uteri. It may be used also in the urethra. The inactive electrode is seen just back of the symphysis pubis, separated from the skin by a wet pad. By means of the diathermy current the heat is passed between the two electrodes; the active electrode being the smaller, becomes the hottest. The thermometer that passes into the core of the instrument registers the temperature of the electrode. (Corbus—*Surg., Gynec. and Obst.*)

INDICATIONS.—The indication for pelvic diathermy is any condition in the pelvis requiring heat, which includes acute and subacute infections, whether gonorrheal or otherwise. Before the days of chemotherapy and estrogenic therapy for gonococcus infections diathermy was a very important method of treating vulvovaginitis in children and gonorrheal infections of the urethra, Skene's glands, and the cervix. For these conditions the corpus electrode was very satisfactory and diathermy is still valuable in those cases that do not respond to chemotherapy and those cases which are sensitive to the sulfonamides. For general pelvic diathermy the belt electrode and the large vaginal electrode are used. Since these treatments should be controlled by some one

familiar with diathermy treatment in general no extensive description of technique is given here. In Fig. 337 the Corbus electrode is shown. Further technical information may be obtained from articles in the Reference List, particularly the article by Waters and that by Krusen.

Cold

In some cases local cold gives more relief than local heat. In most cases, however, pelvic pain, inflammatory or otherwise, is relieved more by heat than by cold, consequently the rule is to use heat first, and if that fails then try cold.

There are several ways of applying cold. The ordinary ice bag is a convenient and satisfactory method. If no regular ice bag is at hand, the ice may be put in a hot-water bag, which does very well as a substitute. The circulating cold water coil may be used for more extensive cold treatment, which extends into the refrigeration treatment already mentioned.

Radiation Treatment

Radiation therapy is useful in a great many pelvic diseases, both malignant and nonmalignant. It may be given with radium or with x-rays or with a combination of the two.

RADIUM

CANCER.—Radium is one of our most effective remedies against cancer. It has a selective action on cancer cells, in so far that cancer cells may be destroyed without destruction of adjacent tissue cells. This selective action depends on the fact that cancer cells are younger, less stable, and consequently less resistant to destructive influences than the surrounding mature tissue cells. This difference in resistance is apparent also in regard to heat. That is, in a cautery incision through a malignant growth the cancer cells are killed over a certain area in which the tissue cells still maintain vitality. This fact has long been noted and used in the handling of malignant growths. If the application of heat be prolonged and carefully graduated, the zone of selective action may be somewhat widened, but at best it is a very narrow zone. With radium, however, the zone of selective action is wonderfully wide. With proper screening, to limit the softer ("burning") rays, the selective devitalizing action on cancer cells may be extended to six centimeters or more. The effective destructive action varies much in different cases, however, and we cannot yet be certain in a particular individual just how far the cancer cells will be completely devitalized. In addition to the direct devitalizing effect on the cancer cells, there is a stimulation of the connective tissue, causing proliferation. This connective tissue proliferation isolates the remaining nests of cancer cells, and the subsequent contraction diminishes their nutrition. In a certain zone this process eventually starves to death the already damaged cancer cells, while farther out the cancer-cell nests lie dormant for a longer or shorter period. It is hoped in time, by proper screening, dosage, and technique of application, to extend the effective selective action so that we can depend uniformly on killing the cancer cells out to the limit of the pelvic cavity. The selection of cases for radium treatment, the combination with x-ray or operation, and other items, are taken up under cancer of the uterus and other forms of cancer.

In the application of radium for pelvic cancer, precautions must be taken against two serious harmful effects. First, there is danger of sloughing, extending into the rectum or bladder or ureters. There is a certain area immediately about the radium in which all tissue is destroyed. The limitation of this area, without interfering with the therapeutic effect of the radium, requires judgment in the use of metallic screening, of tissue screening, and of distance screening by gauze packing. Second, in some cases after heavy radium treatment there has occurred an exaggerated connective tissue contraction, or fibrosis, eventuating in painful nerve constriction and even in occlusion of the rectum, necessitating colostomy. Another late devitalization effect is seen in the bladder ulcers and mild rectal strictures coming on in from one to three years, but yielding very well to local treatment. Further details in regard to these complications will be found under Cancer of the Uterus (Chapter IX).

MYOMA.—Radium is an effective remedy also in selected cases of uterine myoma and in certain cases of persistent uterine bleeding from other causes. It is particularly useful in hemorrhagic conditions near the menopause. The metrorrhagia is diminished or eliminated, and in many cases there is shrinking in the size of the tumor. It is especially indicated in certain patients not in good condition for operation, where malignancy and infection and submucous myoma can be excluded. It is beneficial in selected cases of uterine bleeding from other causes, such as subinvolution, myometrial hyperplasia, and chronic metritis. However, the sterilizing ovarian effect must be kept in mind, and contraindicates this treatment in most patients in the childbearing period. The details concerning the use of radium in uterine myoma and in other forms of uterine hemorrhage are considered in the chapters dealing with those diseases.

Special Knowledge Required.—The safe and effective use of radium in gynecologic conditions requires special radium knowledge and special gynecologic knowledge. In this situation its use is a form of surgery in which the knife is replaced by the more deeply penetrating radium, and carries all the responsibility of other types of pelvic surgery.

X-RAY

CANCER.—In the treatment of cancer, the x-ray has much the same effect as radium. While it lacks the advantage of concentrated application directly to the interior of the cancer, such as radium application within the uterus for uterine carcinoma, it has the advantage of wider distribution of influence. Consequently in extensive uterine cancer, deep x-ray treatment is indicated to devitalize the metastatic cells and the portions of the main growth that lie beyond the effective reach of radium applied within. In certain superficial malignant growths it effects a cure, and in deep-seated growths it usually exercises a marked retarding influence. Improvement in technique and effectiveness is going on rapidly, and there is substantial reason to hope for the later development of uniform curative effects in deep-seated cancers. Sarcoma is especially amenable to its influence. For the present, x-ray and radium treatment should supplement each other—radium for concentrated local application to or within the growth, and x-ray for its widespread influence on

metastases and outlying portions of the growth. The definite selection of cases for x-ray treatment is considered under Cancer of the Uterus and other forms of malignant disease.

OVARIES.—Under the influence of the x-ray, the ovaries gradually atrophy and lose their function. This makes it useful in cases of excessive ovarian activity, as in sexual hyperesthesia (nymphomania). In addition to lessening the ovarian activity in these cases, the x-ray may be applied to the external genitals to diminish the congestion and hypersensitiveness there, though heavy dosage or repeated application to the external genitals must be avoided, as it is likely to lead to troublesome x-ray dermatitis.

In certain conditions in which it is advisable to diminish ovarian activity, x-ray is useful. By continuing the treatment long enough the patient may be rendered permanently sterile. Thus it constitutes a two-edged weapon—one that is exceedingly effective in various directions but requires much care and judgment in handling. There are cases in which sterilization, with the coincident diminution in the pelvic blood supply, would be of great benefit; while in other cases, any effect in this direction must, for various reasons, be carefully avoided.

UTERUS.—The ovarian effect just mentioned tends to diminish the blood supply of the uterus and thus influences favorably nonmalignant pathologic conditions in that region. Properly selected cases of myoma are generally greatly benefited by this treatment. Its use, however, should always be accompanied or preceded by diagnostic curettage, to determine whether or not malignancy is present. As its antihemorrhagic effect is dependable to a considerable extent on its influence in checking ovarian function, its use should be avoided in younger women. The selection of the particular cases suitable for x-ray treatment is taken up under the various topics (Uterine Myoma, Menorrhagia, Metrorrhagia, etc.).

EXTERNAL GENITALS.—X-ray treatment is beneficial in tuberculosis of the vulva. It is used also in pus infections of the skin, subcutaneous tissues, and lymph nodes (acne, boils, carbuncle, cellulitis, and adenitis). However, x-ray treatment for pruritus vulvae and conditions which cause it, carries certain dangers which make such treatment inadvisable, except occasionally to give temporary relief while the condition is being investigated as to type of curative treatment required. This point is considered under Pruritus Vulvae (Chapter IV).

X-RAY A SPECIALTY.—The development of x-ray work generally has become so extensive that it constitutes a specialty in itself. The results depend on the accurate selection and coordination of numerous technical details, which vary greatly in different classes of cases. The best results can be secured only by one thoroughly familiar with the therapeutic use of x-ray in the various affections. The treatment is not given a fair chance when applied in a haphazard way by one familiar only with its diagnostic use. This fact should be kept in mind in every estimation of x-ray results. Again, the wise choice of treatment, x-ray or otherwise, in the various gynecologic affections mentioned, depends, of course, on a careful consideration by the gynecologist of all the methods of treatment, and the selection of the one that will best meet the con-

ditions present in the individual case. The definite selection of cases for x-ray treatment is further considered under the various diseases.

RADIATION IN THE CHILD-BEARING PERIOD

Radium and x-ray are in most cases definitely contraindicated during the child-bearing period, but there are certain exceptions to this general rule. In these cases they should, however, always be used very cautiously and only after less drastic and safer methods have proved of no avail.

In some cases of intractable menorrhagia and metrorrhagia during puberty which have not responded to endocrine medication plus other measures, small doses of radium (never over 300 mg. hr.) may be used, and have in some cases regulated the flow and apparently helped to establish normal menstruation.

In cases of ovarian hypofunction and in certain cases of sterility, small doses of x-ray (20 per cent of erythema dose) or radium (150-200 mg. hr.) have been used to stimulate the ovaries. A few patients with amenorrhea have been caused to menstruate after light x-ray exposure. In this type of case the ovarian function is already below par, and the margin of safety between the stimulating dose and the dose which may cause permanent damage to the impaired organ is so narrow that extreme caution is necessary.

In cases where uterine bleeding is so severe that temporary sterilization is necessary, Wintz has been able to regulate the x-ray dosage so as to destroy follicles of a certain maturity and cause cessation of menses for varying periods, depending on the size of the dose. When the menses become reestablished, they are normal in a large percentage of cases. This is not without danger, however, for occasional patients have had permanent cessation of menses. Another danger which must always be remembered is the effect on the fetus in future pregnancies. Although there have been many cases reported in which normal healthy children have been born after comparatively large doses of x-ray given for castration, there have also been enough cases of malformed fetuses born after doses of x-ray or radium to show that this is a definite factor to consider when giving radiation during the child-bearing period.

Operations

Careful anatomic and pathologic investigations have demonstrated that many pelvic lesions are of such nature and so situated that a cure can be effected by nothing short of operative treatment, with its direct handling of the diseased tissues and extirpation of the hopelessly damaged. In some cases this is evident from the very nature of the lesion. On the other hand, in many cases the question as to whether or not operative treatment will be necessary can be answered decisively only after nonoperative measures have been given a thorough trial.

In pelvic operative work, benefit is secured to the patient ordinarily through one or more of four ways: (a) removal of a diseased structure, (b) correction of a malposition, (c) release of adhesions fixing structures, or (d) restoring lost support. Before recommending operation, the surgeon should have determined that in the conditions present there is a strong probability of being able to do one of these things to the benefit of the patient. For example, when

abdominal operation is being considered for an inflammatory infiltration in the pelvis, it is important to determine, among other things, whether the mass of infiltration is in the broad ligament or in the peritoneal cavity. If it is an adnexal or other mass within the peritoneal cavity, it can probably be extirpated. If it is an infiltration of the connective tissue of the pelvis, the extirpation of any considerable part of it is not a practical proposition, unless complete hysterectomy is carried out at the same time. Preoperative determination of this point (that the trouble is an infiltration of the connective tissue) may save the patient from a futile operation and also point the way to beneficial nonoperative treatment.

The operative measures suitable for the various diseases will be mentioned in the appropriate chapters.

METHODS OF ADMINISTRATION

Various types of administration are employed in gynecologic medication, particularly for the endocrines. Of the common methods (oral, subcutaneous, intramuscular), the oral is ordinarily the most convenient for the patient and the least disturbing and expensive. With the extended use of enteric-coated tablets and the advances in hormone preparations, more and more are being made effective by oral administration. When such are available, the patient may be spared the troublesome "shots" and the frequent office trips which they necessitate. Sevringhaus emphasized the advantages of oral administration in his instructive article "Treatment of the Menopause."

Vaginal suppositories supply local estrogenic effect for building up protective epithelium in atrophic (senile) vaginitis and in the vaginal inflammations of childhood. Estrogenic ointment may be used for local effect on the skin or for absorption through inunction.

Pellet implantation subcutaneously may be employed with benefit in cases requiring gradual absorption over a long period. The methods of implantation are by hollow needle (injector) or by incision, the technique being shown in Figs. 337A and 337B. TeLinde and Bennett give a helpful consideration of clinical results and of the injector technique.

Sublingual administration (absorption from tablet under tongue or between lip and gums) has the advantage of putting the medicine in the general circulation before passing through the liver, where considerable absorption may take place. Walton reports on the sublingual absorbability of various drugs. Some drug firms are making special sublingual tablets—for example, linguets of metandren (Ciba).

Cyclical estrogen therapy (medication interrupted at regular intervals) diminishes disagreeable cumulative effects and is distinctly advantageous. Palmer presents an instructive consideration of this method, and for stilbestrol advises for climacteric symptoms "between 0.1 and 0.5 mg. daily by mouth for twenty-one days, followed by a five- to ten-day interval without therapy. The estrogen withdrawal interval should fall at the time of expected menstruation, and cycles of therapy should be started twenty-four to forty-eight hours after the onset of a new phase of uterine bleeding if it comes."

PELLET IMPLANTATION BY INJECTOR METHOD

The Kearns Pellet Injector (two-thirds natural size)

Unit assembled
for injection
(side view)

Groove into
which pellet
is placed

Hollow needle

Sharp plunger

Blunt plunger

Lateral view of pellet in situ.
Pellets have been placed in
the subcutaneous tissue.
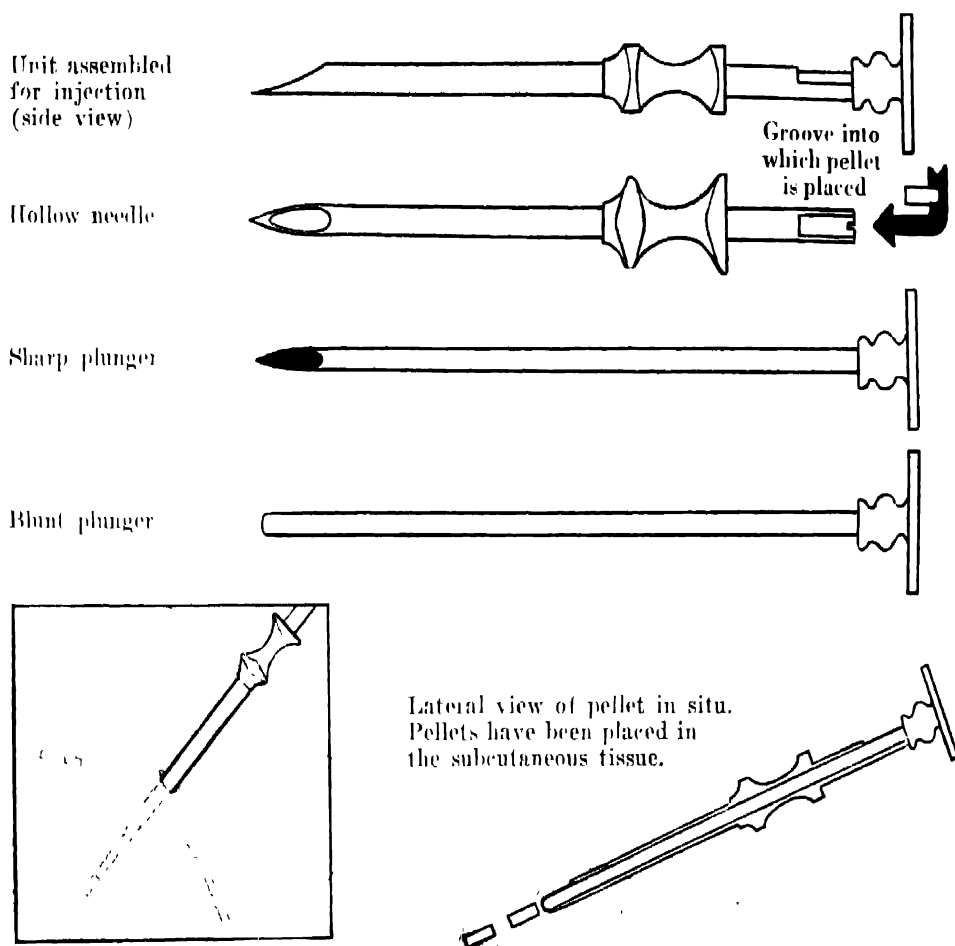
Radial implantation of pellets
in 3 different positions. The
needle is not removed until
all pellets are in place.

Fig. 357.1.—The shape of the pellets adapts them for implantation by injection. The areas usually selected for implantation are the infrascapular region, the lumbar muscle, or the inner aspect of the thigh. The skin is carefully cleaned, followed by iodine and alcohol. The area is infiltrated with procaine 1:200. The needle with sharp plunger in place is inserted either subcutaneously or into the muscle. The sharp plunger is withdrawn and one or two pellets inserted into the needle. The pellets are gently pushed as far as possible through the needle by means of the blunt plunger. One or two pellets are placed at one site, and by partially withdrawing and reinserting the needle additional pellets may be distributed as indicated in the illustration. A later note from Dr. Kearns states that he has found it advisable to deposit all the pellets (even up to six) in one place without shifting of needle. On removal of injector, the small wound may be closed with stitch, skin-clip, or sterile adhesive tape. (From Schering Corporation Bulletin.) (Articles by Dr. W. M. Kearns, J. A. M. A. 112: 2255, 1939; J. Urol. 47: 587, 1942.)

PELLET IMPLANTATION BY SURGICAL METHOD

(All aseptic precautions must be observed)
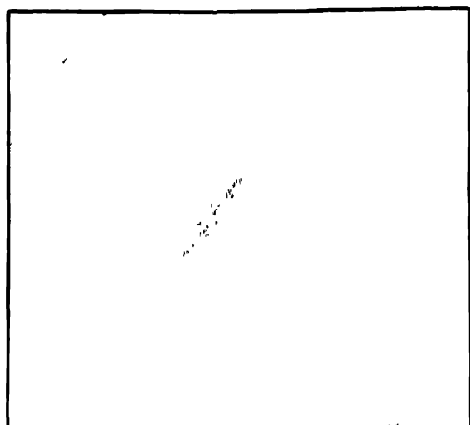
Incision; 3 7 cm.
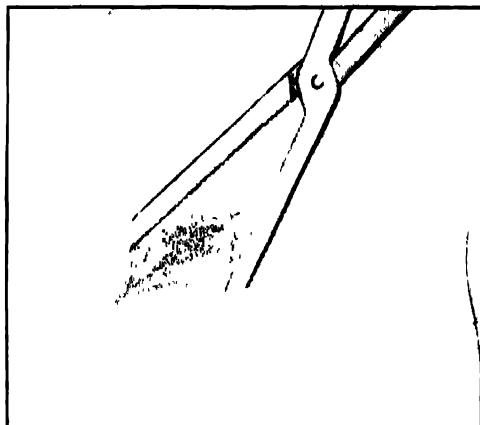
Forming of subcutaneous pockets.
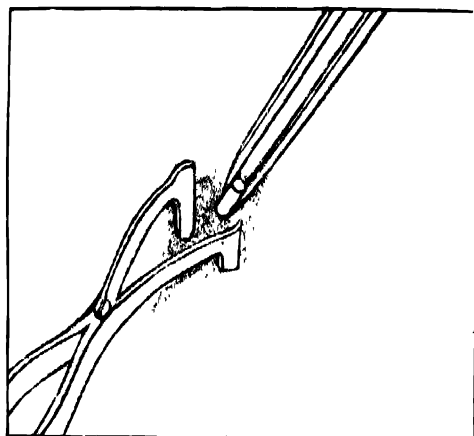
Pocket held open by nasal speculum,
and pellet placed within.
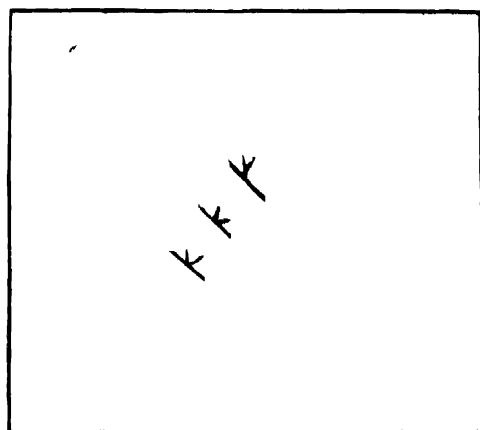
Wound closure

Fig. 337B.—The infrascapular region posteriorly is the preferred site for implantation. The area is prepared with iodine and alcohol, and the site of injection is infiltrated with procaine 1:200 solution. A transverse incision 3-7 cm. in length is made a few centimeters below the inferior spine of the scapula. A number of small pockets (depending on the number of pellets), 3-4 cm. in depth, are then prepared in the subcutaneous fat by blunt dissection. The opening of each pocket in the subcutaneous fat is held sufficiently far apart by a nasal speculum to permit pellets to gravitate to the bottom of the pocket without applying force. This is important, for if the opening of the pocket is too small, the pellet may be crushed by being forcibly inserted. Subcuticular sutures of fine black silk may be used to close the wound. After removing the sutures on the fourth postoperative day, the wound should again be inspected several days later for any tendency toward sloughing. There should be no pain at the site of implantation other than that which occurs from the surgical procedure itself. (From Schering Corporation Bulletin.)

CHAPTER IV

DISEASES OF THE EXTERNAL GENITALS
AND VAGINA

For clinical consideration it is convenient to take up the diseases of the external genitals and vagina in the following order:

Classification

GONORRHEA

OTHER TYPES OF VULVITIS—Intertrigo, Eczema, Herpes, Bacterial Infections, Parasitic Infections, Leucoplakic Vulvitis.

OTHER TYPES OF VAGINITIS—Simple Vaginitis, Diphtheritic Vaginitis, Emphysematous Vaginitis, Trichomonas Vaginitis, Monilia Vaginitis, Atrophic Vaginitis.

ULCERATIVE DISEASES OF VULVA AND VAGINA—Simple Ulcers, Chancroid, Syphilis, Tuberculosis, Granuloma Inguinale, Lymphogranuloma Inguinale, Rarer Ulcerations.

URETHRAL CONDITIONS—Widening of Meatus, Prolapse of Mucosa, Urethral Caruncle, Urethritis (Skene's Glands), Suburethral Abscess.

VULVOVAGINAL GLAND DISEASES—Inflammation, Abscess, Sinus, Cyst, Tuberculosis.

NONMALIGNANT GROWTHS AND SWELLINGS— Condylomas, Stasis Hypertrophy, Tumors, Pudendal Hernia, Pudendal Hydrocele, Varicose Veins, Hematoma, Injuries.

MALIGNANT DISEASES —Carcinoma, Chorionepithelioma, Sarcoma.

MISCELLANEOUS DISTURBANCES— Leucoderma of Vulva, Adhesions of Prepuce or Labia, Hyperesthesia of Vaginal Entrance, Pruritus Vulvae.

(The more pronounced Malformations are considered in Chapter XIII.)

GONORRHEA

Gonorrhea is inflammation of the genital organs produced by the gonococcus. The term, when not qualified, is understood to mean gonorrheal inflammation of the vulva, vagina, and urethra, i.e., gonorrheal vulvitis, vaginitis, and urethritis. If the process extends into the uterus or fallopian tubes or bladder, it causes complications known respectively as gonorrheal endometritis, gonorrheal salpingitis, and gonorrheal cystitis. Gonorrhea is sometimes referred to as "specific" vaginitis or vulvitis or urethritis.

Etiology

Gonorrhea is caused by contact of the affected organs with a gonorrheal discharge, usually in sexual intercourse. The infecting germ (the gonococcus) is a diplococcus, easily stained, and is found in large numbers in the pus cells of all acute gonorrheal discharges. In chronic gonorrheal discharges it is not found so abundantly—in fact, in some cases, it is so scarce as to be very hard to find, and may even disappear entirely for a time.

Though the usual cause of gonorrhea is sexual contact with an infected person, it may exceptionally be caused by other means, as by contact with an infected towel or douche nozzle or chamber utensil or closet seat.

All discharges containing the gonococcus are capable of causing gonorrhea. The slight urethral discharge from a chronic deep urethritis or from a stricture, persisting months or years after an attack of gonorrhea in the male, is very liable to cause gonorrhea when brought in contact with virgin soil.

A sad exemplification of this fact is seen in the many instances in which a bride is infected by her husband, who had gonorrhea years before but supposed himself well. The consequence of such infection is that, instead of a healthy, happy woman with sons and daughters, the wife becomes a confirmed invalid in a childless home. This danger is not sufficiently appreciated by men generally—in fact, the man usually does not know the danger until too late. The responsibility of physicians in this matter is great, for the physician must decide when a man who has had gonorrhea may safely marry. The criteria of cure are given after treatment.

Pathology

In the adult, the thick squamous epithelial lining of the vestibule and vagina is resistant to the gonococcus, somewhat like the external skin surface though to a less degree. But the gonococcus flourishes on the mucous membrane of the urethra, vulvovaginal glands, and cervix uteri. The discharge from these foci irritates the vaginal and vulvar surfaces causing considerable vaginitis and vulvitis which, however, may subside within a short time. Usually only the meatus or lower third of the urethra is involved, hence the urinary symptoms in women are usually mild and of short duration, unless carried higher by too active treatment or by catheterization. Skene's glands, or ducts, in the urethra are likely to be penetrated, and there the process may remain indefinitely.

In the cervix upward extension is often limited for a long time by the internal os. During or following menstruation is the usual time for extension upward, causing acute endometritis and perhaps later acute salpingitis.

Though extension superficially along the mucosa is a striking characteristic of the gonococcus, it does penetrate deeply at times and may be carried to distant parts. The occurrence of gonorrheal joint troubles and gonorrheal endocarditis shows the penetrating power of the germ and indicates the serious complications that may come from the infection. In addition, it opens the way for invasion by other bacteria and, all in all, is a common cause of distant "focal" infections.

In reinfection in adults the process is comparatively mild and is usually limited to certain areas, for example, the urethra or the cervix.

Symptoms

Within a few days after suspicious coitus the patient complains of slight irritation about the genitals. The parts feel dry and uncomfortable, and there may be a slight burning sensation. The feeling of discomfort increases and a discharge appears. About the same time or a little later, there is noticed a smarting or burning on urination and increased frequency of urination. Within two or three days of the beginning of the trouble the discharge is profuse and the signs of irritation (burning and itching and frequent painful urination) are marked.
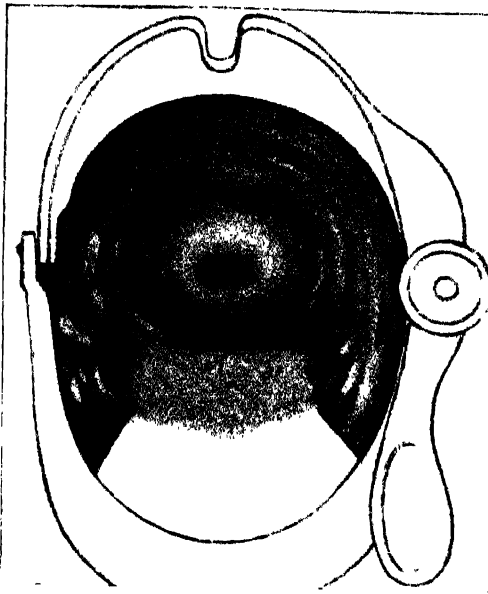
Fig. 338.
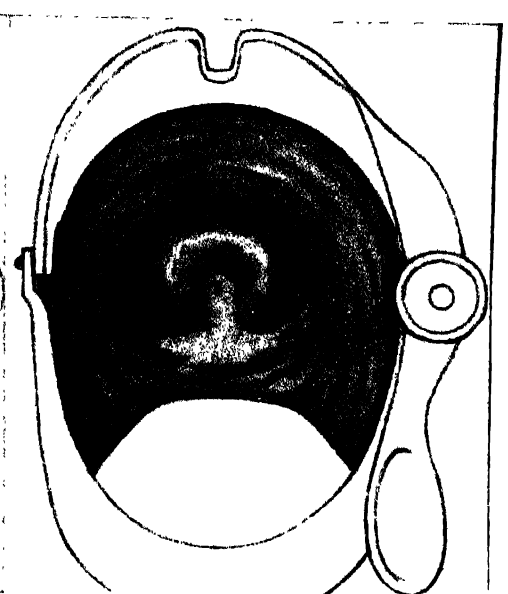
Fig. 339.
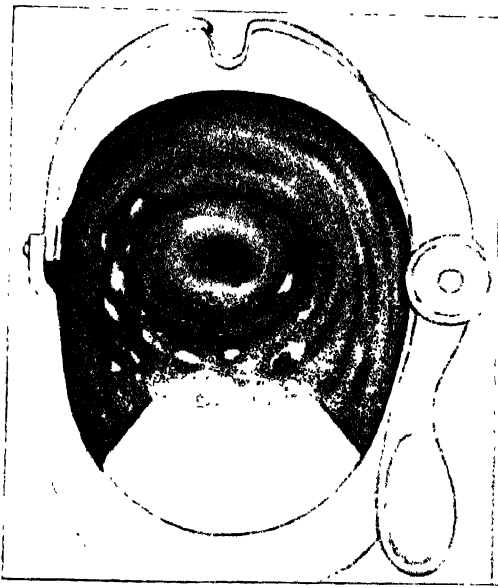
Fig. 340.
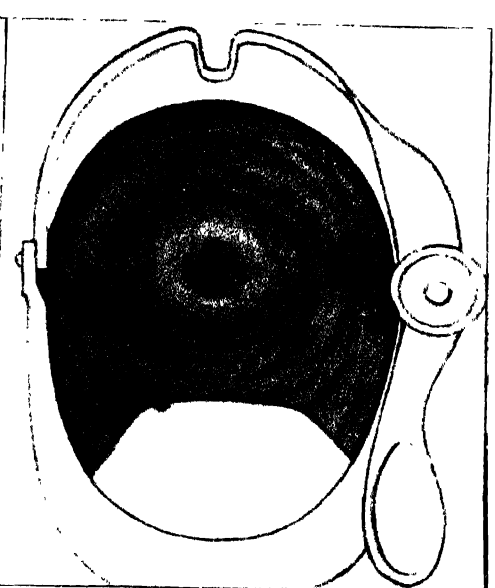
Fig. 341.

Fig. 338.—Trichomonas vaginitis, showing the thin yellow discharge with general redness of the vaginal wall and hemorrhagic spots (minute ulcers). In some cases there are gas bubbles in the discharge. The cervical canal is clear—no yellow plug as in gonorrhea.

Fig. 339.—Gonorrheal vaginitis. The inflammation is principally in the cervical canal, which is filled with a yellow plug of tenacious mucus. This tenacious yellow discharge extends out into the vagina, causing some vaginitis. But there is no severe vaginal inflammation with hemorrhagic spots as seen in trichomonas vaginitis.

Fig. 340.—Monilia vaginitis, showing the general redness and the white areas of membrane. When the membrane is scraped off there is likely to be a raw red surface underneath. The discharge is usually small in amount.

Fig. 341.—Atrophic (senile) vaginitis, showing the general redness, due to the atrophic thinning of the epithelial layer of the mucosa and the tendency to punctate bleeding wherever the wall is rubbed. The discharge, if any, is scanty and mostly clear. (Modified from Karnaky's drawings as reproduced by G. D. Searle & Co.)

On inspection, the structures immediately surrounding the vaginal orifice are found reddened and painful on pressure. There is a yellow discharge from the vagina and frequently some discharge from the urethra.

On digital examination, the vaginal walls are found rough and hot and tender. Pressure on the anterior vaginal wall directed from the upper end of the urethra to the meatus, may bring to view one or more drops of urethral pus. If the case has passed beyond the acute stage, the pain and discomfort are not so marked, but the discharge, more or less profuse, is still present.

Diagnosis

Gonorrhea must be distinguished from vulvitis and vaginitis due to various other causes. When a patient comes with a rather severe vaginitis, there are four types in particular to be considered, namely, trichomonas, gonococcal, monilia, and atrophic. The special features of each are shown in Figs. 338 to 341. *Trichomonas vaginitis* is the type present in a large proportion of the cases of persistent or recurrent vaginal inflammation of considerable severity. If examination be made after omission of douche for a few days, one may usually observe the characteristic appearance shown in Fig. 338. Covering the tip of the speculum is a pool of thin yellow pus. In addition to the general redness of the vaginal wall, punctate hemorrhagic spots may be seen. These are likely to be grouped; the grouping perhaps representing the activity of one organism or of two or more working close together. The wall presents also streaks of the yellow pus, but no patches of membrane and usually no yellow roll of cervical pus.

In *gonorrheal vaginitis*, there is generally a thick and tenacious yellow roll of pus coming out of the cervical canal, as shown in Fig. 339. This jelly-like yellow roll is stringy and difficult to clear out of the cervix. The discharge in the vagina is somewhat similar though there is admixture of thinner discharge from the vaginal wall. *Mycotic vaginitis* (usually monilia) is less frequent and the patches of membrane as shown in Fig. 340 is characteristic. Brushing off a patch of membrane reveals the red inflamed surface beneath it. *Atrophic vaginitis* may be quite severe, with distressing burning and itching, with very little discharge. The scarcity of discharge with the annoying symptoms is one of its features. In addition, there is the general redness of the vaginal wall due to the atrophic (senile) thinning of the lining epithelium. Also, wherever the wall is brushed with some pressure there appear fine bleeding points, as shown in Fig. 341. The slight trickle of blood from the points may join and form a drop, rolling down on the speculum. In addition to the above-mentioned special appearances, there are often associated conditions which assist in differentiation. In gonorrheal inflammation, there is a tendency to involve the urethra and the vulvovaginal glands as well as the cervical mucosa. The decisive diagnostic factor is the demonstration of the gonococcus by staining and if necessary by culture.

Staining the Gonococcus.—A specimen for staining is made by smearing a little of the discharge, preferably from the urethra or from a Bartholin gland, on a slide near the end. The corresponding part of another slide is then pressed on the film and the two are drawn apart. This gives two identical specimens, one for the blue staining and one for the

gram-negative staining if that should be found necessary. It is advisable to make specimens from the urethra, from a Bartholin gland, and from the cervix if discharge is found in these locations. The slides are allowed to dry and are labelled.

The specimen to be stained blue is fixed to the slide by being passed two or three times through the flame. It is stained by flooding for fifteen seconds with a 1 per cent solution of methylene blue. It is then rinsed with water, the excess of which is removed by gently blotting with filter paper. After the slide is thoroughly dry it is examined with the oil emersion lens. A cover glass is not needed, the immersion oil being dropped directly on the stained specimen.

The gonococcus and other bacteria stain very dark in comparison with the cell nuclei. The characteristic distribution of the gonococci is well shown in Fig. 342. The roll-shaped diplococci are grouped within the pus cell. This fact is shown by the relation of the group to the stained nuclear parts of the cell and by the rounded outline of the group, the spread of which is limited by the outer cell wall (which does not stain). Cells may disintegrate and release gonococci which are then seen free in the intercellular spaces. A general view of the specimen with the characteristic grouping of intracellular colonies (Fig. 342) is of course best seen with the medium high-power objective, while the individual shape and pairing of the cocci (Fig. 343) are clearer with the oil immersion.
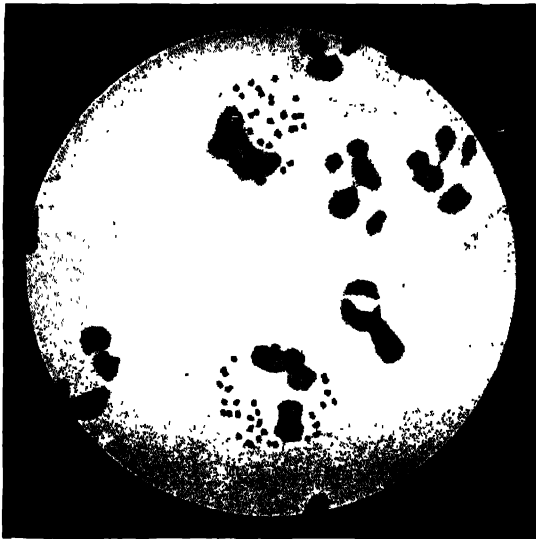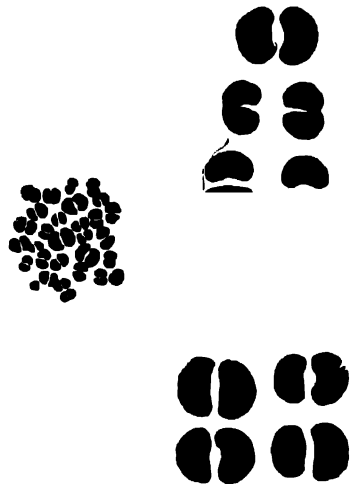
Fig. 342.   Fig. 343.

Fig. 342.—Specimen of pus from a case of gonorrhea, stained with methylene blue. This field contains two gonococcus colonies, each within a pus cell. Only the nuclei of the pus cells are seen. The lower colony has the circular outline of the cell containing it. (Kolle and Wassermann—*Handbuch der Pathogenen Mikroorganismen.*)

Fig. 343.—Indicating the shape of the diplococcus of gonorrhea (gonococcus). (Byford—*Manual of Gynecology.*)

In chronic cases, however, this picture is not usual. There may be only a few organisms and of these only one or several pairs may be found within the cells. In that case, the diagnosis cannot be made positively, since other organisms found in the vagina may give the same picture. Since many, if not most, of these organisms are gram-positive, staining by Gram's method will help clear the doubt. The diplococcus catarrhalis, however, which is found in the vagina occasionally, cannot be thus distinguished, since it is an intracellular organism and is gram-negative. In doubtful cases it may be necessary to differentiate these organisms by cultural methods.

Tiedemann's Modification of Gram's Stain. A thin smear is dried without heat and flooded with a 2 per cent solution of crystal violet (Hoechst) in methyl (wood) alcohol. The stain is allowed to act for fifteen seconds and is then removed by allowing distilled water to drop slowly from a burette onto the slide for fifteen seconds. It is then washed briskly with distilled water.

The slide is now flooded for fifteen seconds with a solution containing 1 gram of iodine and 2 grams of potassium iodide to 100 c.c. of distilled water. This solution is poured off and the slide flooded with 95 per cent alcohol until no more color is given off. This takes about ten seconds. The slide is then washed with water and dried. It is advisable to counterstain very lightly with a solution of carbolfuchsin diluted with ten times its volume of water. Gram-positive bacteria appear bluish black, while gram-negative bacteria, if counterstained, appear a pale red.

Significance of Microscopic Findings

As already stated, in *acute* or subacute cases there is rarely any difficulty in determining certainly whether the trouble is or is not gonorrhea, the symptoms and bacteriological findings coinciding and settling the matter.

In *chronic* cases, on the other hand, there is often great difficulty. If a few apparent gonococci (shape, groupings, situated in pus cells, decolorized by Gram's method) are found, the diagnosis is not positive, though the strong probability is that the lesion is gonorrheal, if the history and ordinary examination findings point that way. The difficulty is due to the fact that the micrococcus catarrhalis, mentioned above, has the same staining points. Consequently, in cases where the history and clinical findings do not conform to the staining evidence, further differentiation should be made by culture. Though difficult to culture, bacteriologists have developed a satisfactory method by which the gonococcus may be cultured and identified. Also, the blood serum fixation test (complement fixation test) may assist in deciding whether or not a deep inflammatory focus is gonococcal.

It is important to trace down the diagnosis thoroughly in all doubtful conditions. The following is a case in point:

A middle-aged couple, referred for treatment for gonorrhea, gave no history of suspicious contacts, were clearly people of good standing and respect in their community, and with full trust in each other. They were greatly distressed by this strange thing which had come into their lives. Even without suspicions and on the assumption of innocent extragenital contamination, the presence of this loathsome disease which might spread to internal organs or contaminate some other member of the household was a consuming worry. Both husband and wife had developed a troublesome discharge which persisted in spite of treatment. Their physician sent specimens to a laboratory, and the report came back ''gonorrhea.''

Our examination, the vaginal discharge showed apparent gonococci—intracellular and gram-negative. But they were very few compared to the free discharge, which if gonorrheal should have shown gonococci in abundance. Also, the inflammation did not have the usual localizations of subacute gonorrhea (urethra, Bartholin glands, cervix) but involved the surfaces in a more general way. Examination for trichomonads showed none, but there had been frequent douching. Specimens were sent to a reliable laboratory for cultural differentiation of the gram-negative intracellular cocci, and the douches were stopped. By means of cultural differentiation, complement fixation test, and examination of repeated specimens from wife and husband, it was established that (a) the inflammation was of the trichomonas type (trichomonads eventually found in both wife and husband), (b) the gram-negative intracellular coccus was the *Micrococcus catarrhalis,* and (c) there was no gonorrhea. Such an experience emphasizes the importance of coordinating the laboratory and clinical findings, and the necessity of most careful investigation in an atypical case.

In addition to staining, culture, and complement-fixation test in a doubtful chronic case, the following items may give some help: (a) evidence of invasion of Bartholin's glands or of Skene's glands, (b) history of salpingitis, following the vaginal inflammation, (c) sterility, and (d) history of former gonorrhea in the husband.

Treatment

Before stating in detail the methods, it is desirable to make clear the principal purposes of the treatment. They are as follows:

a. To Prevent Extension Upward of the disease to the endometrium and fallopian tubes. The extension to the fallopian tubes is a most serious result of gonorrheal infection and condemns a large proportion of the victims to chronic invalidism or to a serious operation. In either case, there will probably be sterility.

b. To Relieve the Discomfort attendant on the inflammation and to prevent contamination of the patient's clothing and surrounding objects with the discharge.

c. To Eradicate Completely the Infection from the lower genital tract so that no infective discharge will remain. As long as one spot of gonorrheal inflammation remains in the vagina, in the vulvovaginal glands, in the urethra, or in the uterus, the discharge is infective and is a source of danger to the patient and to those around her. At any time, there may be an extension upward to the tubes or there may be infection of the eyes of the patient or of someone else in the household. It is probable that a considerable number of the cases of gonorrheal vulvitis in children come from accidental infection from a contaminated towel or closet seat, in the home or elsewhere.

Details of Treatment

Since the discovery of the drugs of the sulfonamide group the treatment of acute gonorrhea has been revolutionized. At present, the member of the group giving the quickest and most reliable results is sulfathiazole. Fortunately it is also the one which is usually best tolerated. Other sulfonamides which have been used are sulfanilamide, neo-prontosil, and sulfapyridine. A new one under investigation at present is sulfadiazine. In patients who cannot take any of the sulfonamides, pyridium is fairly successful.

In the Washington University Gynecological Out-patient Clinic a five day treatment of acute gonococcal infections with sulfathiazole was carried out by Dudley R. Smith, who in a personal communication gave the following summary of 70 patients treated. Each patient was given four grams (60 gr.) of sulfathiazole daily for five days. She was instructed to stop the medicine if she noticed persistent nausea or dizziness or other unusual disturbance. No blood count nor check as to blood level of the sulfathiazole was made. In only one case was it necessary to discontinue the medication. This patient had severe headache after the first and second dose, so the treatment was stopped. The patients were seen once a week for culture, and only those with negative specimens for sixteen weeks were considered cured.

Of the seventy cases, 64 per cent were cured, as evidenced by bacterial cultures for sixteen weeks, and 36 per cent lacked proof of cure. This 36 per cent was distributed as follows: 12 per cent admitted promiscuous reinfection, 12 per cent did not return, 6 per cent were uncooperative, 2 per cent were transferred to the hospital on account of abscess, and 4 per cent did not respond to the drug. Of the 36 per cent, 6 per cent were frank failures, while the remaining 30 per cent may or may not have been cured, but they were counted not cured by the criterion adopted. If the series included only those who cooperated, the percentage of cures rises to 94 per cent.

A lactic acid douche to remove irritating material helped to make the patients more comfortable. Eight of the patients were pregnant. One of these miscarried (twins) two months after treatment. Six were delivered, each with normal child, normal puerperium, and negative culture six weeks post partum. One is still undelivered, with negative culture.

In cases which do not respond to sulfathiazole, a combination of sulfathiazole and fever therapy will usually effect a cure. In patients who cannot take the sulfonamides, pyridium is the next choice of drugs. Two tablets are given three times a day until the urine is a brick-red color. Then the daily dose is regulated so that that color of the urine is maintained for ten days to two weeks, and the smear is checked.

In explaining to the patient the necessity of keeping the infected surfaces covered, and of changing the pad often and of washing the hands well afterward each time, take particular care to **arouse no suspicion** that might lead to domestic infelicity.

Your work is to lessen suffering, not to cause it. If the patient should become apprised of the fact that her husband has been untrue to her and in addition has brought to her a loathsome disease, her suffering would be far greater than any physical distress that might result from the disease, even though it goes on to pelvic suppuration requiring operation.

The authors have no sympathy for the man who commits adultery and brings a disease of the women of the streets to the pure woman whom he has promised to love, cherish, and protect. He reaps his reward in due time. It is not to protect him that the need of caution is mentioned, but to protect the woman herself from unnecessary suffering. This can usually be accomplished by the exercise of a little tact. To the patient's question, "What is the trouble?" a good answer is "Inflammation." Then pass quickly to the directions concerning treatment. At a convenient time, mention that the discharge is irritating and that she must be careful that none be carried to the eyes on contaminated fingers or serious inflammation of the eyes may result. The patient usually becomes so interested in the treatment that she forgets to inquire as to the cause of inflammation. However, if she asks, as they sometimes do even when having no suspicion, "Doctor, what is the cause of inflammation?" the usual reply is: "Inflammation is due to various causes," in a tone that shows that the physician has neither the time nor the inclination to give the patient a course in medicine in order that she may understand all the details about inflammation. This rarely fails to stop troublesome questions. Of course, some patients are so suspicious that they will not stop questioning until they have all the information they can possibly secure, while others are well aware of the nature of the trouble and question the physician out of curiosity or to see whether he has a grasp of the situation. With such, much time need not be wasted. Do not tell them the exact nature of the trouble when you do not think best to do so, neither tell them an untruth. When pressed too closely, simply remind them that their principal desire is to get well, that they have come for treatment, that they are receiving treatment, and have been given all the information necessary to treatment. If not satisfied with that they may go elsewhere for care.

Of course, some patients know or will probably find out in a short time the nature of the trouble. But it is preferable that they find out from some other source, if at all. Your imparting the information, or confirming that imparted by some of their anxious friends, will probably do no good and may do much harm.

Criteria of Cure

In the authoritative symposium on The Gonococcus and Gonococcal Infection published in 1939 by the American Association for the Advancement of Science, the criteria of cure are considered at length, the following quotations and data applying to the female.

"Adult. In the female the problem of determining the cure is considerably more difficult than in the male. Here the accurate determination of the absence of all clinical evidence of the infection is of the utmost importance, probably more so than the bacterio-

logic procedures. Such an examination presupposes adequate training in the recognition of the slight evidences of gonococcal infection in women.''

Such a thorough search, besides determining the presence or absence of symptoms such as frequency, dysuria, discharge and pain, includes careful expression of the urethra and periurethral glands (Skene's glands) for discharge, examination of the Bartholin gland of each side, the cervix uteri, the parametrial tissues, and the tubes and ovaries, and the securing of the following microscopic data.

1. Series of successive smears and cultures from the urethra, cervix, and Bartholin's glands must be negative. The time for taking the specimens should be arranged so as to secure a series before, during, and after menstruation.

2. Provocatives, if used, should be followed by smears and cultures from the above sites.

3. Repetition of above series of examinations five times at monthly intervals is recommended.

''Child. In female children the infection of the vagina as well as the cervix makes it difficult to determine the point at which the patient is ultimately cured. Relapse after apparent cure is very common. Here again the absence of discharge and signs of inflammation of the vulva, vagina, and cervix are the first essentials.''

Following this come the same series of specimens for microscopic examination and culture as mentioned above for the adult, except that for the child rectal specimens also are advised.

Comments

The publication covers the various ramifications of the subject including review of the use of sulfanilamide and allied drugs, the social-community aspects of the problem and the place of the laboratory in the diagnosis.

''Cultures. The inclusion of culture for the gonococcus in the above procedures is an essential additional laboratory check. In order that it may have any significance, proper facilities for taking and transporting the specimen, a well-equipped laboratory and well-trained technician must be available. Without such facilities very little additional reliable information can be obtained.

''If such facilities are at hand both the smear and cultural evidence must be considered. While the cultural examination records a greater percentage of those having gonococci, a number of cases will present positive smears and have negative cultures. Since the advantage of cultures has been amply demonstrated by Carpenter, Leahy and Wilson (1938) it follows that the above facilities should be available and used in conjunction with smears.

''Blood Test. The meaning of the complement-fixation test for gonococcal infection is at the present time too ambiguous to be of much value in determining the presence or absence of the disease. It is not possible to ascribe any consistent uniformity of interpretation to the results obtained by this test as evidenced by the evaluation made by Jacoby, Wishengrad and Koppman (1938). The test at present with the best technique shows too large a percentage of false positive results to be used as a criterion of cure.

''Provocatives. The ability of provocative measures to liberate tissue-locked gonococci is extremely meager. This is particularly true in the female where there is a greater diversity of tissue involvement. The types of provocatives employed include local irritation by instrumentation or chemicals, or physiological stimulation of secretion by parasympathetic stimulants such as escrine compounds applied locally or choline compounds introduced by iontophoresis, or by producing increased glandular activity in the cervix by negative galvanism, or by general stimulants, such as injection of vaccine, the metabolic products of the gonococcus, foreign proteins such as milk or nonspecific organisms.

''The recently inflamed mucosa is naturally sensitive, and irritation whether of local or general origin may cause an appearance of discharge. Only if such irritation produces a liberation of the gonococci deep in the tissues is it of any value as a means for determination of cure. In our experience such gonococcal liberation has been extremely rare. In spite of this it may be well, especially at this time, not to overlook any procedure that may possibly bring into the open even as little as 1 per cent of uncured gonococcal infection.''

Treatment of Chronic Gonorrhea

A chronic gonorrheal discharge is due to persistence of the specific inflammation in one or more isolated areas. When such a discharge persists after the inflamed surfaces generally have returned to normal, make careful search for its exact source. The situations in which the inflammation is likely to persist are the following:

Skene's glands, in the urethra.   Cervix uteri.
Vulvovaginal glands or ducts.   Corpus uteri.

In Skene's Glands.—When the gonorrheal inflammation invades these periurethral ducts, it may remain there indefinitely, causing symptoms of chronic urethritis or chronic cystitis and a persistent infective discharge. There is redness about the urethra and pouting outward of the swollen urethral mucosa. If the patient has passed through parturition, the opening of the duct on each side may usually be seen by rolling out the urethral mucosa as explained under Examination in Chapter II. If the duct is open, a drop of pus may be pressed from it. If the duct is closed, a small abscess forms.

To **treat** these conditions, the infected glands may be destroyed by excision or cautery or coagulation, using a small needle electrode, or the Corbus electrode with diathermy may be used for local heat treatment.

In Vulvovaginal Glands or Ducts.— Persistence of the gonorrheal inflammation in the duct of a vulvovaginal gland is indicated by reddening about the mouth of the duct and by a discharge from it, a drop of which may usually be pressed out. Microscopic examination of this discharge usually shows gonococci in abundance, though in some old cases they may disappear temporarily. If the gland shows evidence of chronic involvement (firm nodule in that situation) it requires extirpation, for as long as it remains it prevents complete cure and the discharge from it is a source of danger.

If an abscess forms in the gland, it is opened freely. If the abscess is well developed so that all septa are destroyed and the recesses form part of the main cavity, there may be complete healing afterward and an end of the trouble. If a second abscess forms later, however, that means that portions of the infected gland remain, and in such a case, all the involved indurated tissue should be extirpated.

While waiting for a vulvovaginal abscess to mature for opening, the free application of unguentum Credé may assist in relieving the discomfort, if hot packs are not sufficient. In cases with any focus of inflammation which cannot be extirpated, for example, salpingitis, sulfathiazole internally is to be considered. Persistent inflammation at the vaginal vault is due usually to an irritating and infective discharge from the cervical canal. The chronic uterine infection may be located in the cervix or in the body of the uterus. When there is persisting inflammation at the vaginal vault without involvement of the cervical canal, the cervical discharge being clear mucus, suspect trichomonas vaginitis or other type, and investigate and treat accordingly.

Fever Therapy.—Fever therapy has been used in extensive gonorrheal inflammations, with remarkable effects in relieving pain and resolving exudates.

This form of treatment requires extensive and reliable apparatus, specially trained attendants, and careful selection of cases by a physician familiar with the indications and contraindications. Under proper precautions and experienced supervision this type of therapy may bring great relief in cases not responding to less radical measures. Fever therapy is especially helpful in treating serious gonococcal complications, such as ophthalmia, arthritis, and endocarditis.

Gonorrhea in Children

Gonorrheal infection in female infants and children is more frequent than is generally appreciated. Most of the infections are due to accidental contamination from soiled clothing or toilet seat or from the fingers of the mother or attendant. The diagnosis should be made by culture, as it is very difficult to differentiate the *micrococcus catarrhalis* from the gonococcus by ordinary staining methods.

The inflammation usually stops in the vagina. Extension upward to the tubes and peritoneum is infrequent but occasionally occurs. Asch calls attention to the fact that this should be kept in mind as a possible etiologic factor in obscure cases of peritonitis in children and also in tubal occlusions found later in life without apparent cause. Gonorrheal vaginitis in early childhood may cause adhesions of the vaginal walls, which obliterate the vagina to a greater or less extent. Such condition seen in later life may be mistaken for a congenital atresia of the vagina.

Treatment

It is now established that estrogenic treatment by means of vaginal suppositories is a satisfactory method of handling chronic vaginitis (gonorrheal or otherwise) in children.

In 1934, R. M. Lewis reported on the use of theelin in the treatment of gonorrheal vaginitis in children. The results were obtained through the action of theelin on the vaginal epithelium.

Principle of Treatment.—In the immature girl the vaginal epithelium is only three or four cells thick, while in the adult it is many-layered. With infection in the immature, the epithelium becomes still more thinned and in some cases disappears in areas. Allen, experimenting on monkeys, found that estrin injection caused a marked hypertrophy of the vaginal epithelium, so that it became many layers thick, resembling the adult type. Lewis applied this principle to the treatment of children with gonorrheal vaginitis, and found that the thin immature epithelium became greatly thickened and that the gonococci disappeared.

Since this original work by Lewis, instructive reports have been made by Brown, Miller, TeLinde, and others. Miller states, "The apparent simplicity of the reports might lead one to the hasty conclusion that a lasting cure is easily obtainable. The questions which must be answered are (a) is it an arrest or cure that takes place, (b) how often and permanent are the 'cures,' and (c) are there any deleterious effects on the children?" His conclusions from the study of his series were: 1. Gonorrheal vaginitis in children may be cleared

up promptly in most cases by the estrogenic treatment. 2. Relapses are frequent. 3. Acute cases require longer treatment than the chronic. 4. Other vaginal infections respond to this treatment.

TeLinde, in a paper at the American Gynecological Society meeting in 1935, presented the results of a careful study of different methods of administering the estrogenic hormone in these cases. He used amniotin, and gave it in four ways: orally, hypodermically in solution, hypodermically in oil, and

Fig. 344 -- Gonorrheal vaginitis in a child. Note the immature, ineffective epithelial covering of the vagina. (TeLinde—*Am J. Obst. and Gynec.*)
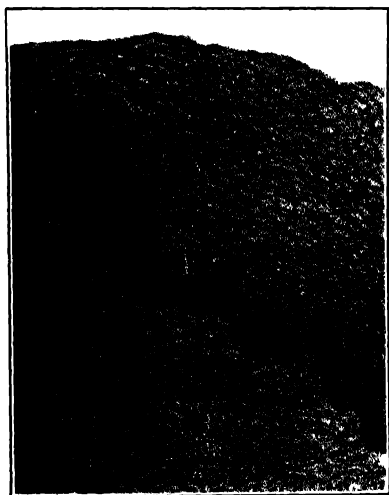
Fig. 345.
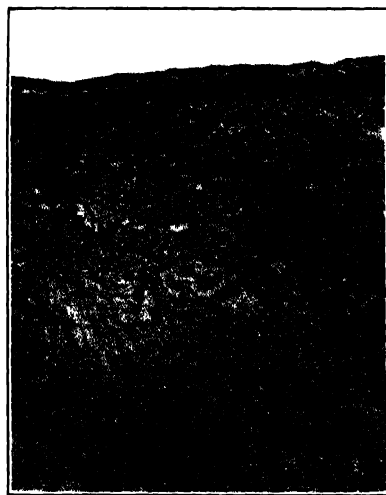
Fig. 346.

Figs. 345 and 346.—Fig. 345, estrogenic effect in building up a protective epithelium and eliminating infection, in an immature vagina. Fig. 346, same case as shown in Fig. 345, showing return to normal immature epithelium after cessation of the estrogenic treatment. (TeLinde—*Am. J. Obst. ant Gynec.*)

vaginally by suppositories. The results were checked by microscopic examination of specimens of the vaginal mucosa excised for that purpose, and also by examination of the vaginal discharge.

Fig. 344 shows gonorrheal vaginitis in the immature vagina with its ineffective epithelial covering. Fig. 345 shows the effect of potent estrogenic treatment in building up protective epithelium and eliminating the infection. Fig. 346 shows the return to the normal immature epithelial layer after cessa·

tion of the treatment. From this instructive experimental work, checked by sections of the affected mucosa, TeLinde obtained results as shown in the accompanying table:

METHOD	PATIENTS	CURED	PER CENT CURED	AVERAGE DAYS OF TREATMENT	AVERAGE NUMBER ESTRIN UNITS USED
Oral	6	1	16	123	191,600
Hypo-Ethylene-Glycol Sol.	10	1	10	19	950
Hypo. in Oil	22	16	72	27	4,206
Vaginal Suppositories	17	17	100	27	2,024

In clinical work, the effect of the treatment is checked by examination of spreads of the vaginal discharge, as shown in Figs. 347 and 348. As the built-up epithelium goes back to the normal immature thinness when the estrogenic effect wears off, it is important to continue the treatment until the infection is entirely eliminated; otherwise there will be reinfection when the protective thickening of the epithelium disappears. Sources of reinfection, especially in the rectum, must be discovered and removed.

In a later report, TeLinde summarizes his results and conclusions as follows:

We have reported the cure of 175 patients with gonococcic vaginitis by amniotin. All (except sixteen of those to whom the product was given hypodermically in oil) were cured by the use of amniotin vaginal suppositories. We have yet to encounter a patient who failed to get well by this method of treatment, and we consider it a very satisfactory way of dealing with the disease. A follow-up of our first 100 patients, from three months to two and one half years after the last treatment, showed ninety-eight of them well. We saw no clinical evidence of harm due to the treatment, and laboratory investigations confirm this observation.

We feel that the increased acidity brought about in the vagina by the action of the estrogen is a factor in overcoming the infection, but, since our results were not nearly so good when another acidifying suppository was employed, we believe that amniotin introduces an additional factor. We are inclined to think that this other factor is the covering of the vagina with thick epithelium, which prevents reinfection of the subepithelial tissues and thus permits the inflammatory process in them to subside. Our clinical observations and biopsies have indicated that the essential lesion of gonococcic infection of the lower part of the genital tract in female children is vaginitis.

An instructive study of 250 cases was presented by Schauffler, Kanzler and Schauffler. Their conclusions in regard to treatment were as follows:

"1. A clinical evaluation of our experience with distention with silver nitrate ointment in ninety-nine cases, amniotin by vaginal application in thirty-one cases, pyridium suppositories in nineteen cases and various other methods in smaller series leads to the conclusion that amniotin by vaginal application is the most satisfactory method of management we have used to date.

"2. This study includes 261 cases in which sulfanilamide was used orally. Only a few of these cases have been reported elsewhere. The results and opinions indicate that the method is unsatisfactory as used to date. The reason may be inadequate or inconstant administration of the drug. The desired low pH of the vagina may be important in relation to the ineffectiveness of sulfanilamide. Meticulous care during treatment requires hospitalization—a disadvantage. The method as used thus far apparently does not compare favorably with other available methods.

"3. Evidence from a rather painstaking study indicates that the endocervix is seldom an important factor in relation to these infections—practically never so in younger children."

They made also the following observations: "Endocervix. We agree with TeLinde that infection of the endocervix is seldom a factor of importance. In our experience we regarded the potential effect of estrogen on the endocervix with some concern. The possibility that the rudimentary glandular structure might assume the more infectible adult type seemed feasible . . . but did not materialize."

Russ and Collins report the use of diethylstilbestrol in children. The child, irrespective of age, was given a 1-mg. tablet three times daily until twenty were given. The tablet was crushed and given in 60 c.c. of milk. They had very few adverse symptoms, and the treatment rarely required more than seven days. Their cures were close to 100 per cent. They feel that an advantage of the

Fig. 347.

Fig. 348.

Fig. 347.—Vaginal spread in a case of gonorrheal vaginitis before treatment. (TeLinde—Am. J. Obst. and Gynec.)

Fig. 348.—Vaginal spread in a normal immature vagina after treatment. No bacteria or pus cells. (TeLinde—Am. J. Obst. and Gynec.)

oral administration over the suppositories is that it eliminates the chance of the child becoming "genital conscious" as well as the rapidity and permanence of the cure.

The sulfonamides have not displaced the estrogenic treatment yet, but since such excellent results are being obtained in adults with sulfathiazole, its use in children may soon be reported. Schauffler, Kanzler and Schauffler found sulfanilamide treatment unsatisfactory in children on account of the special care required to avoid danger, though it gave a high percentage of cures.

Gonorrhea After the Menopause

In gonorrheal vaginitis after the menopause, the same problem of dealing with a thin nonprotective epithelial covering due to lack of estrogen hormone is encountered, and the same treatment with vaginal suppositories is beneficial in taking care of this factor in the situation.

OTHER TYPES OF VULVITIS

In addition to inflammation of the external genitals due to the gonococcus, there are other inflammatory disturbances which occur in this locality, such as intertrigo, eczema, herpes, bacterial infections, parasitic skin diseases, and that atrophic condition designated leucoplakic vulvitis.

Intertrigo

Intertrigo is a hyperemic condition of the skin, with slight maceration and consequent irritation. The patients usually refer to it as "chafing" or "heat." It is due to prolonged contact and friction of opposed surfaces. The normal skin secretions are retained between the approximated surfaces and
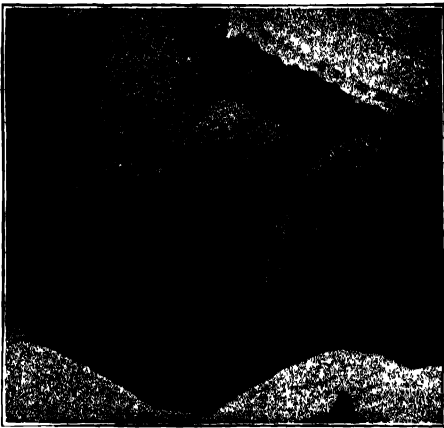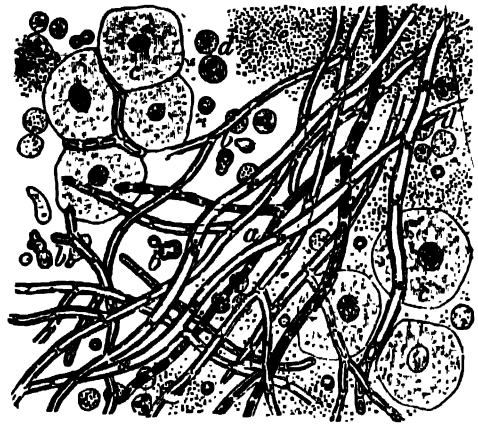
Fig. 349.   Fig. 350.

Fig. 349.—Monilia (thrush) vulvitis and intertrigo in a girl baby. (From Sutton and Sutton after Schamberg—*Diseases of the Skin*, The C. V. Mosby Co.)

Fig. 350.—Mycelium and spores of the thrush fungus (monilia). (Holt—*Diseases of Children*, D. Appleton-Century Company.)

become decomposed and irritating. It occurs most frequently in stout women and in infants, because in them the skin surfaces are in contact more constantly and over a wider area. It is aggravated by vaginal discharge and is usually worse in hot weather.

It is most often located in the genitocrural creases, but may spread inward over the labia or outward over the thighs and upward on the abdominal wall. At first, intertrigo consists simply of hyperemia and slight irritation of the skin, but may soon become complicated with monilia (thrush) (Figs. 349 and 350) or by trichophyton implantation (Figs. 351 and 352).

The treatment consists of cleansing and soothing applications, such as 10 per cent argyrol, the free use of a drying powder to eliminate moisture between opposed surfaces, and special measures required for any complication such as thrush infection or trichophytosis or eczema. In severe cases (probably complicated) Tulipan obtained best results by spraying the parts with a 5 per cent solution of tannic acid through an atomizer. This was applied two or three times daily. If there was much secondary infection, he used a spray of 2 per cent solution of brilliant green over the tannic acid. He found relief usually immediate, and the condition cleared in a few days.

Eczema of Vulva

Vesicular eczema of the vulva is most frequently located on the labia majora. The vesicles break and form crusts,. and an itching, inflamed discharging surface persists. Chronic erythematous and squamous eczema also may occur, in which case the skin is infiltrated and may become nodular. The eczema may be limited to the vulva or it may extend to the adjacent cutaneous surfaces or into the vagina.

The causes and symptoms and treatment of eczema of the external genitals are practically the same as for eczema elsewhere. Consult dermatologic textbooks, as there is not space here for detailed consideration of the many features of eczema.

Herpes of Vulva

Herpes may occur on the vulva, where it is known also as "herpes progenitalis." The vesicles of the herpetic eruption are usually of larger size than those of vesicular eczema. Furthermore, they occur in groups and do not rupture easily, whereas the vesicles of eczema rupture spontaneously, causing a sticky discharge. Herpes is seldom accompanied by the intense burning and itching which characterize eczema. Herpes occurs especially in nervous women, particularly when there is marked pelvic congestion from any cause. With some women it occurs at nearly every menstrual period.

The discomfort from uncomplicated herpes is so slight that not much treatment is required. The parts should be kept clean and dry and may be dusted frequently with some drying powder, for example, equal parts of zinc oxide and prepared chalk. All irritation should be avoided. If there is troublesome pruritus or burning or smarting, a sedative lotion or ointment may be used.

Bacterial Infections of Vulva

Staphylococcus and streptococcus infections may occur about the external genitals, either localized to the skin glands or as a diffuse process as in erysipelas or cellulitis.

Follicular vulvitis occurring in adults is characterized by the inflammation being confined principally to the hair follicles and sebaceous glands. The inflamed structures are represented by small red tender papules scattered over the labia somewhat on the order of local acne or furunculosis.

Erysipelas of the vulva, like erysipelas elsewhere, is a rapidly spreading inflammation produced by the *Streptococcus pyogenes*. In the beginning there is usually a chill, followed by considerable fever, and the general disturbance usually associated with fever. The patient complains of heat and throbbing in the external genitals. The fever continues and swelling of the vulva is noticed. The patient then comes for examination. In the diagnosis, differentiate from scarlatinal rash on vulva, from intertrigo, from bichloride rash, from cellulitis of vulva, and from hematoma.

Cellulitis of vulva is that form of vulvitis caused by ordinary pus bacteria (usually the *Staphylococcus pyogenes aureus* or *albus*) penetrating to the subcutaneous connective tissue and causing inflammation there. It is known also

as "phlegmonous," vulvitis and as "lymphangitis" of vulva. It lacks the superficial parchmentlike induration of erysipelas.

Anything that causes an abrasion about the vulva, through which bacteria may reach the connective tissue, may lead to phlegmonous vulvitis. Any of the previously mentioned forms of vulvitis may be followed by this form. Injuries to the vulva or furunculosis may lead to the same. The pathologic changes are the same as in cellulitis elsewhere.

Gangrenous vulvitis is known also as "noma." It is inflammation of the vulva of such severity that the nutrition of the structures is cut off and they become gangrenous. Extensive sloughing may take place.

Gangrenous vulvitis occurs almost exclusively in patients in whom the normal tissue resistance has been destroyed by exhausting general or local diseases. Local conditions interfering with the pelvic circulation, such as pregnancy and pelvic tumors, predispose to this affection.

Its most frequent victims, however, are children who are poorly nourished and poorly cared for. In such it is often fatal. The exanthemas, particularly when occurring in sickly children, may cause gangrenous vulvitis. Diphtheria infection, which occasionally is located about the genitals, may lead to sloughing unless recognized and treated promptly.

Treatment.—In the treatment of these bacterial invasions of the external genitals, the determination of the cause or type of infection is the important step, for that indicates the type of treatment required in that particular case. In the mild cases, a soothing local application and the use of a lactic acid douche to remove any irritating discharge may be all that is required. In acute inflammatory conditions, such as cellulitis and erysipelas, rest in bed and cold or hot applications may give temporary relief. Surface discomfort and irritation may usually be relieved by application once or twice daily of an argyrol or other soothing solution or ointment. Unguentum Credé applied freely often gives marked relief, and is supposed to have some effect in checking the underlying inflammation. For internal administration, the sulfonamides are to be considered as in other serious infections. In erysipelas not yielding promptly to other measures, erysipelas antitoxin is to be considered, and also bacterin or vaccine treatment.

Parasitic Infections

Trichophytosis of Vulva (Tinea of Vulva, Tinea Cruris).—This is one of the four ordinary parasitic diseases of the skin, the other three being moniliasis, pediculosis, and scabies. These parasitic invasions occur about the external genitals as elsewhere on the body surfaces. They give rise to much irritation and, unless search is made for the fungus or other parasite, the patient may be treated ineffectually for a long time.

Trichophytosis or tinea vulvitis is ringworm of the genitocrural region, which masquerades under a variety of designations. It is due to the tinea trichophytosis or large-spored ringworm fungus, of which there are several slightly different varieties. The variety most frequently found here is the epidermophyton, hence the affection has been termed "epidermophytosis inguinale." In tropical countries, where it is more frequent and severe, it is often designated "dhobie itch," to indicate its origin from contamination of clothing in laundry operations ("dhobie" meaning laundry).

Trichophytosis of vulva should be suspected whenever a mild dermatitis of the vulva and adjacent portions of the thighs resists cleansing antiseptic and drying treatment, especially if spreading by a well-defined margin. If allowed to persist it may become extensive, as in Fig. 351. The usual method of examining for the skin fungi is to put some scraped-off scale on a microscopic slide, add a small drop of 10 per cent potassium hydroxide solution, put on a cover glass, and examine for the mycelium and spores, stopping down the light to give outlines. Trichophyton fungi are shown in Fig. 352.

Blumenthal and Snow call attention to the fact that the fungus does not always show in this direct examination, and advise cultures and describe a rapid and convenient method.
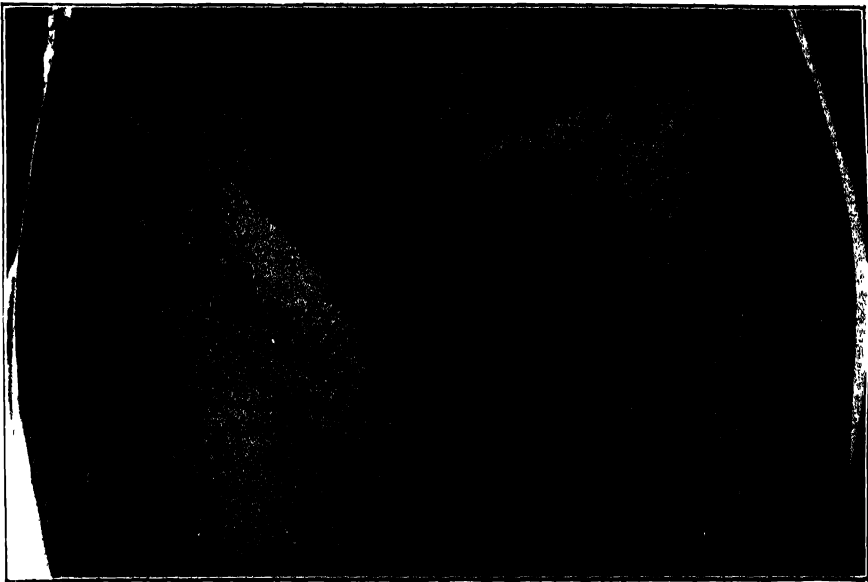
Fig. 351.—*Tinea cruris*, showing extensive involvement. The parasitic and inflammatory lesions about the external genitals produce some troublesome diagnostic problems. (From Sutton and Sutton after Mackee—*Diseases of the Skin*, The C. V. Mosby Company.)

As to **treatment,** an effective antiseptic and antipruritic solution is the compound resorcinol lotion (mercuric chloride, 0.18; resorcin, 9; 70 per cent alcohol, q.s. ad. 180 c.c.). The temporary smarting is usually followed by prolonged relief from the pruritus. Rubbed into the affected surfaces night and morning it stops the growth of the fungus, and eventually eradicates it, though skin irritation or possibly bichloride absorption from prolonged use on large surfaces are to be kept in mind. If talcum is used, watch to see if the patient is allergic to the powder employed.

If the above solution stirs up too much irritation, the following ointment may be used:

℞	Gm.
Pine tar ointment	1.2
Salicylic acid	2.4
Precip. sulphur	4.8
White vaseline	60.0

Sig.: Apply as directed.

It may be advisable at times to use these two prescriptions alternately—the ointment at night and the resorcinol lotion during the day.

The varied lesions of epidermophytosis and the accompanying dermatophytids (specific skin reactions to tinea products) and dermatitis from prolonged application of tineacides, may create such a complex clinical picture that special dermatological study is necessary for differential diagnosis and successful treatment, hence the advisability of consulting a systematic work on dermatology in any resistant case.

Moniliasis of Vulva (Diabetic Vulvitis).—Monilia (yeast fungi) invade the vagina and external genitals when conditions are favorable. Mild skin irritations such as intertrigo in children favor such invasion, as shown in Fig. 349. The diagnosis is confirmed by finding the mycelium and spores of the yeast fungus (Fig. 350) in a microscopic specimen prepared as just explained for showing the trichophyton fungus. The **treatment** is the same as given for monilia vaginitis, with which it is usually associated.
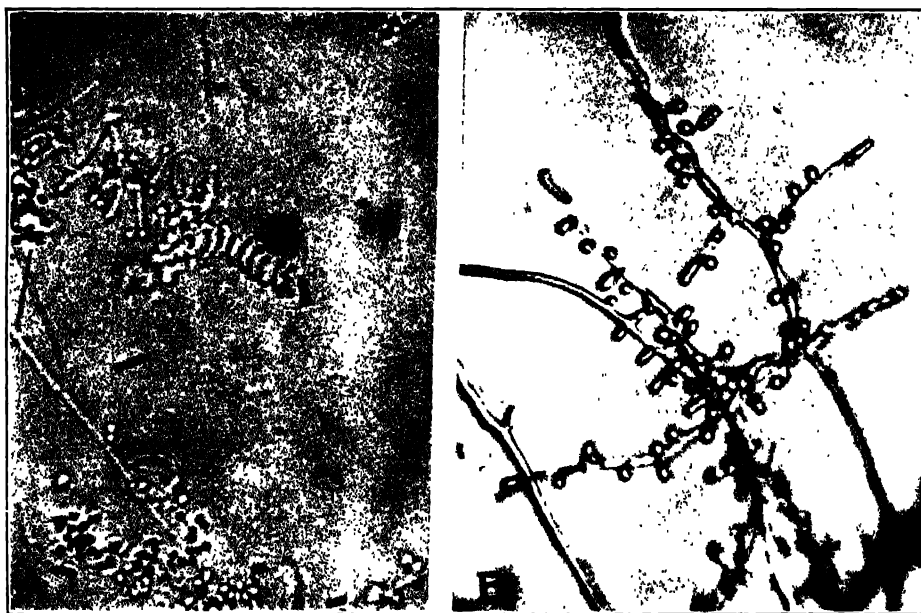
Fig. 352.—Microscopic characters of common pathogenic fungi. (From Dr George Lewis and Dr. Mary Hopper, New York Skin and Cancer Unit.)

A, Trichophyton gypseum. Spirals are characteristic of *T. gypseum.*

B, Trichophyton crateriforme. Microconidia may be attached or unattached singly or in clusters, and are seen in many species of fungi. (From Sutton and Sutton—*Diseases of the Skin.*)

In diabetic individuals the excretion of sugar in the urine favors the growth of yeast fungi, and often leads to marked vulvar irritation and pruritus. Diabetic vulvitis presents a characteristic glazed edematous appearance, with uniform redness but no ulceration or papules or other circumscribed lesion to account for the burning and itching.

Examination of the urine shows sugar, and the vulvitis will continue until it is cleared. In all persisting pruritic conditions about the genitals, the urine should be carefully checked for sugar or other substances that may irritate the surfaces. Hesseltine has emphasized that monilia infection is an important

factor in the distressing vulvitis of diabetics, and he was able to make a mild monilia infection in a nondiabetic patient worse by applying glucose to the vulva.

Pediculosis Pubis.—Pediculosis pubis is an infrequent parasitic disease of the vulva. The pediculus pubis or "crab louse" (Fig. 353) differs from the pediculi found on other parts of the body. It inhabits the pubic hairy region and may give rise to much irritation. It is conveyed from one person to another by contact, usually in sexual intercourse.

There is itching and consequent scratching, with resulting abrasions and vulvitis. The diagnosis is made by finding the parasites, which are attached to the hairs near the skin. At first they may not be noticed, but on close inspection they are seen as small brownish particles attached to the hairs very close to the skin.

The **treatment** is to apply oleate of mercury (10 per cent) once daily, rubbing it well into the hairy region. After the remedy has been applied for four or five days it may be washed off, and need not be applied again unless there develops evidence that some of the parasites escaped destruction. At the end of the treatment, a soap and water bath and complete change of underclothing must take place. An excellent and effective preparation used in the
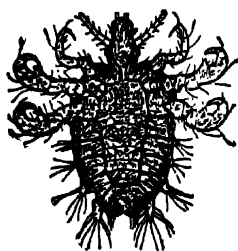
Fig. 353—The pediculus pubis, magnified. (Stelwagon.—*Essentials of Skin Diseases*, W. B. Saunders Company.)

same way is Kaposi's petroleum salve. Some recommend to shave the pubis or to clip the hair there, but that is usually not necessary. If there is much local irritation remaining after the parasites are killed, soothing applications may be required.

If a solution is preferred, the following is advised by Fantus and Cornbleet:

Acetous Mercurial Lotion (Mild)

R

Mercury bichloride	0.06 Gm.
Diluted acetic acid	6.00 c.c.
Diluted alcohol	120.00 c.c.

M. Label: Apply to affected parts twice daily.

Scabies.—Scabies may appear about the external genitals as part of an extensive development of scabies, the infection usually appearing first on the fingers. There are the usual symptoms—severe itching, worse when the body is warm, and the abrasions and irritation resulting from scratching. The diagnosis is made by finding the burrows of the itch mite on other portions of the body, usually on the fingers.

The **treatment** consists of a warm soap-water bath followed by the free use of sulphur ointment. Immediately after the bath, the patient should rub the ointment thoroughly into all the infected areas, and put on clean underclothing. The inunction should be repeated night and morning for three days, the same underclothing and the same bed linen being used during the course. On the fourth day a warm soap bath should be taken and clean underclothing put on. If some irritation of the skin remains, a mild ointment, such as zinc oxide ointment or vaseline, may be used for a few days. If any of the burrows containing the *Acarus scabiei* escape the first unction course, another similar course must be carried out.

If something other than ointment is desired, there are "sulphur foam" applications on the market (Wyeth) put up with three cloth applicators to the box.

Leucoplakic Vulvitis

Leucoplakic vulvitis is an affection of the external genitals characterized by whitening and atrophy and shrinking of the skin, with obliteration of the normal folds and a change in the consistency of the epidermis by which it becomes inelastic and parchmentlike and cracks easily.

Fig. 354.—Leucoplakic vulvitis: hyperplastic stage. Note from above downward: first, the greatly thickened layer of keratin cells (hyperkeratosis) ; second, the increased number of eleidin cells, forming an almost black band ; third, the granular zone sending long papillary processes of epithelium into the connective tissue (acanthosis) ; fourth, the connective tissue showing marked round cell infiltration, most marked directly beneath the epithelium. (Taussig— *Am. J. Obst. and Gynec.*)

Under "atrophic diseases" of the vulva are classed leucoderma (vitiligo, pigment atrophy, "white spots") and leucoplakic vulvitis (atrophic sclerosis, chronic atrophic vulvitis, kraurosis). Kraurosis is a term applied by Breisky to a condition of marked contraction about the vulvar entrance. The word is

derived from the Greek and means "shriveling up," and describes this feature of the lesion very well. This feature, however, may be due to different pathological conditions. It is only a symptom, and hence is not a satisfactory term for a distinct disease. Leucoplakic vulvitis and other conditions presenting atrophy and contraction at some stage are still designated "kraurosis" in the
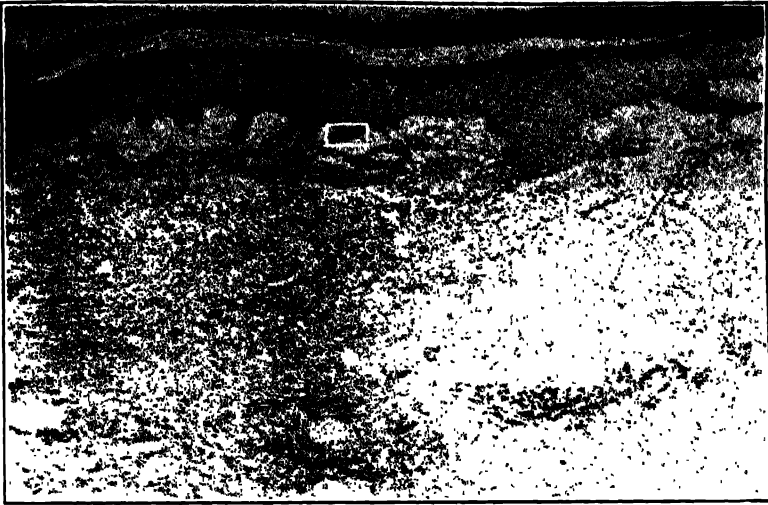
Fig. 355.

Fig. 356.

Figs. 355 and 356.—Leucoplakic vulvitis. A stage midway between the hyperplastic and atrophic condition. Fig. 355, Low power field, showing a zone of pigmented hyperkeratosis, eleidin layer still marked, epithelial layer sending short processes downward, and beginning development of collagenous areas in the connective tissue directly beneath the epithelium. Fig. 356, High power of area outlined in Fig. 355, showing collagen formation in the connective tissue. (Taussig—*Am. J. Obst. and Gynec.*)

Fig. 357.—Leucoplakic vulvitis, showing a stage farther advanced than that in Fig. 354   Middle stage. Marked collagen formation in the connective tissue.   Gyn. Lab.
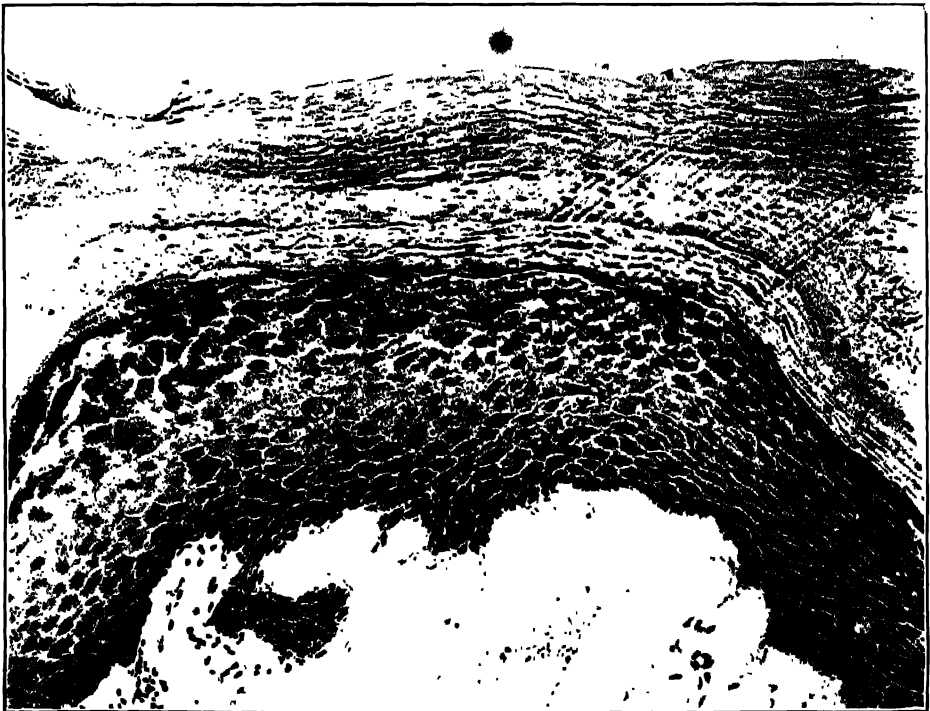
Fig. 358.—High power of Fig. 357, showing, from above downward, the layer of hyperkeratosis, the black band caused by the increased number of eleidin cells, the short papillary projections of epithelium, and finally the collagenous connective tissue.   Gyn. Lab.

literature of European countries but, as Taussig points out, the use of this old ambiguous blanket term serves only to confuse the picture, and should be dropped.

As to **etiology,** leucoplakic vulvitis has in different cases been preceded by eczema and other chronic inflammatory diseases of the vulva, by pruritus vulvae with resulting scratching and traumatism, by removal of the uterine appendages and by chronic vaginal discharge. It has been attributed to each of these conditions, but apparently none of them constitutes the essential factor in its development.

Age seems to be a definite factor in the etiology, for it occurs almost exclusively in women near or past the menopause. This would seem to indicate that it is connected with the senile atrophic changes and absence of ovarian hormones, but that does not explain why it occurs only occasionally. As cutaneous atrophy is such a marked feature, it has been surmised that it is due to an atrophic affection of the nerves of the parts. Marked changes in the nerves have been demonstrated, but whether such changes are primary or secondary is uncertain.

Pathology.—Taussig's investigations and accurate recording and analysis of extensive clinical experience with the disease have established leucoplakic vulvitis as one of the important diseases of the external genitals. It causes marked distress at various stages of its progress, effective treatment usually requires an extensive and particular plastic operation, and if allowed to persist it is very likely to eventuate in cancer.

The lesion is generally bilateral, being unilateral or asymmetric in only about one-third of the cases. When bilateral, it is usually symmetric and is present as a butterfly area of parchmentlike skin. In the early stages the skin is red, swollen, dry, and excoriated. In the second stage there is thickening of the skin and a flattening of the labial folds. There are white semiopaque patches on the skin. In the third stage the skin is parchmentlike, cracked, and a bluish white color. In the fourth and final stage there is a smooth white shiny skin, and a complete obliteration of all folds.

As to microscopic features, in the early stage there is a marked edema, round cell invasion, and increased vascularity. In the epithelial layer there is a marked prolongation of the papillae. Deposits of eleidin or keratohyalin are seen in the upper layers of the epithelium. The keratin layer is a little thicker than normal. One of the characteristic changes noted in this condition is the absence of the normal elastic fibers in the spaces between the papillae. This shows as a very light staining area.

In the later stage the epithelial layer becomes thinned out and the papillae are flattened. The keratin layer becomes markedly thickened and occupies from one-half to two-thirds of the epithelial layer. The basement layer of cells is not distinct as it is in the early stage but presents a frayed-out appearance. The tissue beneath the epithelium loses its cellular character. The elastic fibers are entirely absent in the affected area. In the cellular area there is a large amount of glairy, collagenous tissue containing some mast cells, plasma cells, and occasionally clumps of round cells. The microscopic characteristics are shown in Figs. 354 to 359, with normal skin in Fig. 360 for comparison.

Fig. 359.   Fig 360.

Fig. 359.—Leucoplakic vulvitis, advanced, showing the marked atrophic change in the epithelium and underlying tissues. Weigert-van Gieson stain showing the absence of elastic fibers. Gyn. Lab

Fig. 360.—Normal vulvar tissue showing normal epithelial layers and subepithelial tissue. Weigert-van Gieson stain showing normal quantity of elastic fibers, which stand out black with this stain. Gyn. Lab.
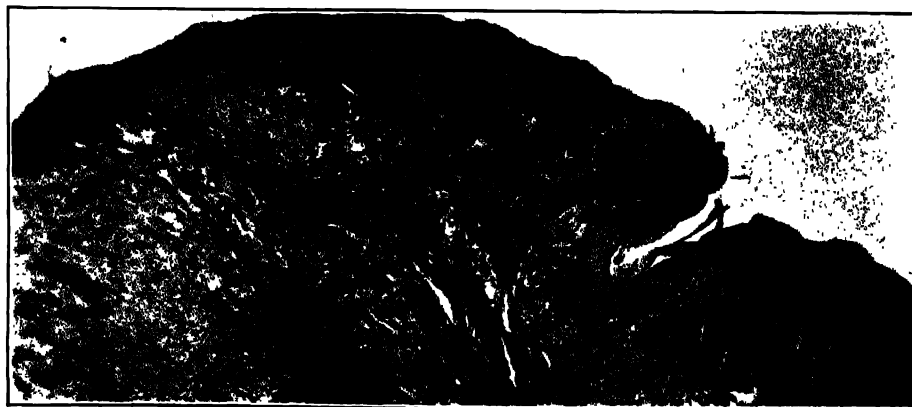
Fig. 361.—Squamous-cell carcinoma of the vulva on a leucoplakic basis. At the right edge of the section is seen the leucoplakic epithelium. This ends abruptly at the edge of the carcinoma which is seen in the right central portion of the picture. Gyn. Lab.

As to **malignancy,** over half of the extensive series of vulvar cancer cases reported by Taussig had leucoplakic vulvitis as an etiologic factor. An example is shown in Fig. 361, and the matter is considered further later under vulvar cancer.

Symptoms and Diagnosis.—In the beginning there may be a low-grade inflammation appearing in spots just outside the vaginal opening on the labia. As the disease progresses the older portions lose their color and elasticity, and become white and dry and crack easily and tend to shrink (Figs. 362, 363). The atrophic contraction may progress to a marked narrowing of the vaginal opening, as shown in Fig. 364. The glandular structures (sweat glands, sebaceous glands, and hair follicles) are slowly obliterated by pressure atrophy, leaving simply atrophic decolorized inelastic tissue covered with a thin layer of epithelium.
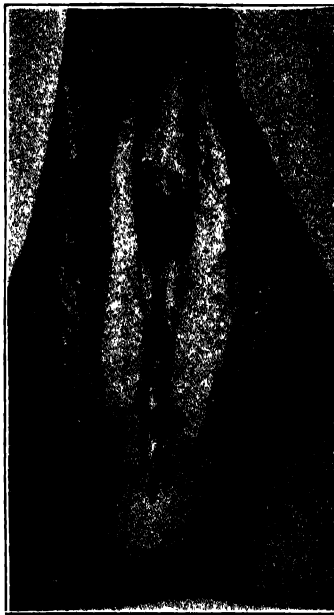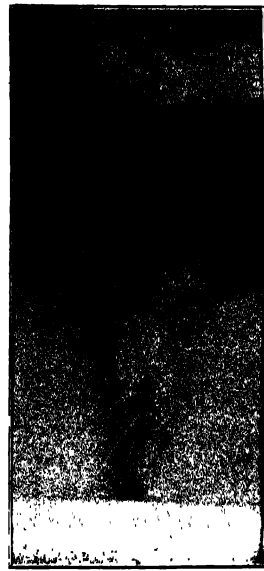
Fig. 362.   Fig. 363.   Fig. 364.

Fig. 362.—Leucoplakic vulvitis with kraurosis (early stage). The prepuce and perineum show leucoplakia. (Taussig—*Am. J. Obst. and Gynec.*)

Fig. 363.—Carcinoma of the prepuce of the clitoris, an everting cauliflower nodule developing from the parchment-like leucoplakic vulvitis involving both labia, prepuce, and perineum. (Taussig—*Am. J. Obst. and Gynec.*)

Fig. 364.—Leucoplakic vulvitis with marked shrinkage. (Hirst—*Diseases of Women,* W. B. Saunders Company.)

The tissue changes mentioned are usually accompanied with burning and itching and tenderness. Owing to the sensitive spots and narrowing of the vaginal orifice, coitus may be painful or impossible. As the tissues are brittle, care must be exercised in the examination to avoid causing additional fissures to add to the patient's discomfort. Leucoplakic vulvitis is one of the causes of severe and persistent pruritus vulvae, though not all of the patients are so disturbed.

The differential diagnosis presents little difficulty, as the appearance and palpable signs are characteristic. In ordinary leucoderma of this region, the affected skin is normal except for the absence of color, there are no troublesome symptoms, and there may be leucodermic spots elsewhere on the body.

Treatment.—Temporary relief may be afforded by the applications mentioned under Vulvitis and under Pruritus Vulvae. The probability that the atrophic changes are partly due to diminution in ovarian function would indicate a thorough trial of ovarian hormones to aid in checking the progressive process. X-ray treatment, carefully administered, may give considerable temporary relief, but its use carries danger in two directions. First, the temporary relief afforded may postpone effective treatment until cancer develops. Second, x-ray treatments in this situation may start an x-ray dermatitis which is more troublesome than the original affection.

When the involvement is extensive or troublesome, excision of the affected tissue is indicated—not only to relieve the patient's suffering but also to forestall the development of carcinoma. The chronic irritation and cellular changes of leucoplakic vulvitis constitute an important factor in the origin of malignant disease in this situation. As leucoplakic vulvitis is a progressive disease, the excision should include those structures likely to be later involved, which are the labia majora, labia minora, clitoris, and most of the perineal surface. This requires particular work in avoiding troublesome scar contraction about the urinary meatus and vaginal opening and in covering the raw surfaces, without too much tension. It should be undertaken only by one experienced in surgical work in this region. It is taken up in detail in our Operative Gynecology.

OTHER TYPES OF VAGINITIS

In addition to vaginal inflammation due to gonorrhea there are other types to be considered, namely, simple vaginitis, diphtheritic vaginitis, emphysematous vaginitis, trichomonas vaginitis, monilia vaginitis, and atrophic vaginitis.

Simple Vaginitis

Simple vaginitis is inflammation of the vagina due to irritation or to the ordinary pus germs.

Etiology.—The normal vaginal secretion is destructive to the ordinary pus germs and tends to protect the vaginal wall, as well as the cervix uteri, from infection. Anything that lowers the nutrition of the vaginal wall interferes also with the protective action of the vaginal contents and hence predisposes to inflammation. Debilitating diseases of every kind have that effect to some extent as have also the exanthemas. An irritating uterine discharge or bacteria introduced from without may cause vaginal inflammation. A pessary worn too long without care may cause local inflammation or even ulceration. In children, foreign bodies sometimes keep up inflammation over a long period before discovery. Fig. 365 shows the method of investigating for a foreign body in any case of persistent vaginitis in a child.

The **symptoms** are discharge and discomfort. There is serous and cellular exudate in the vaginal wall, and the superficial layers of epithelium are thrown

off and form part of the discharge. The **diagnosis** of simple vaginitis depends on excluding the various special forms of vaginitis, such as gonorrheal, trichomonas, monilia, and atrophic (senile, adhesive).

The **treatment** consists in removing the cause (see etiology) and giving a mild douche, such as a teaspoonful of lactic acid to two quarts of warm water. In children and in patients past the menopause, estrogenic suppositories assist in restoring the protective epithelial covering and in throwing off the infection.
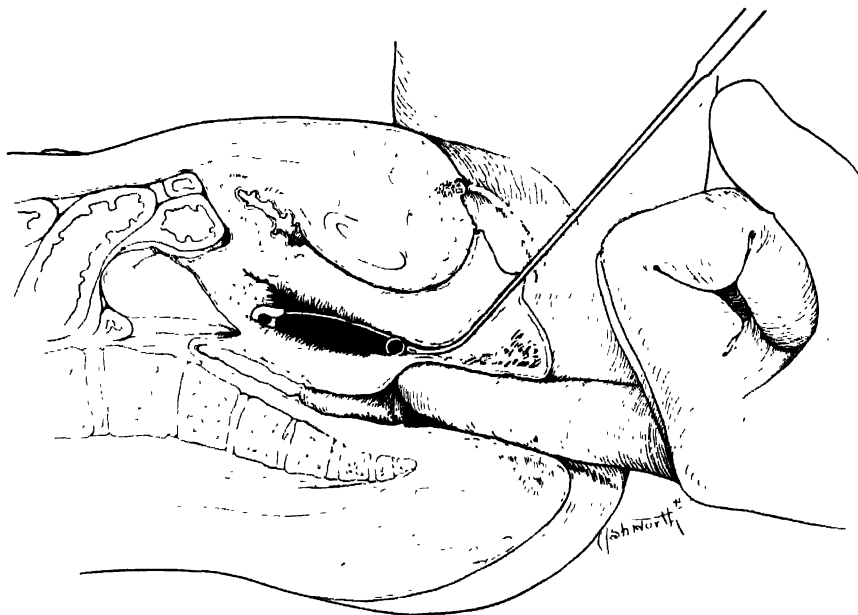
Fig. 365.— Schematic drawing illustrating diagnostic method and methods of removal, with little finger of left hand in the rectum. The rectal finger greatly facilitates location of the foreign body and appears definitely to distract the child's attention from the vaginal manipulation. Small forceps may be used for extraction in the same way. (Schauffler—*Calif. and Western Medicine*)

Diphtheritic Vaginitis

Diphtheritic vaginitis may be found in a child suffering with throat diphtheria or it may be even a primary lesion. It may occur also in an adult in the home with a diphtheritic child. Many years ago when diphtheria was frequent, in examining a patient brought into the hospital with puerperal fever, some small patches of membrane were noticed in the vagina. It was a question whether they were streptococcic or diphtheritic. Microscopic examination showed the latter, and the disease responded promptly to antitoxin.

In diphtheritic vaginitis in a child, atresia of the vagina may follow. We had one such case, in which there was almost complete occlusion of the vagina by a circular scar in the upper third. Careful dissection under the guidance of rectal palpation, followed by treatment with estrogenic suppositories, gave a good result.

Emphysematous Vaginitis

In emphysematous vaginitis, small collections of gas appear under the epithelium or in the meshes of the connective tissues. It is a rare form of vaginal inflammation and occurs almost exclusively in pregnant women. Its

seat is the upper part of the vagina and the vaginal portion of the cervix. The little air vesicles vary from the size of a pinhead to several times as large. They are frequently surrounded by an area of hyperemia, but the inflammatory reaction is slight. When punctured the air escapes and the vesicle collapses. There is rarely any secretion from them. The gas contained in them is, in part at least, trimethylamine. The vesicles show little tendency to re-form after puncture. The affection is due to a mild gas-producing bacillus. Apparently, however, it bears no relation to infection with the gas-forming bacillus known as the *Bacillus aerogenes capsulatus,* for this deadly germ gives rise to a severe and rapidly spreading phlegmonous inflammation.

As to the treatment of emphysematous vaginitis, nothing more is usually required than puncturing the air vesicles and washing the vicinity with an antiseptic solution. If there is an irritating discharge, mild antiseptic douches may be given. If the patient is pregnant, great care must be exercised not to cause much irritation, as an abortion might result.

Ingraham and Hall presented an instructive study of emphysematous vaginitis, with sections of vaginal wall showing the gas vesicles.

Trichomonas Vaginitis

There is a very troublesome form of vaginitis associated with the presence of the *Trichomonas vaginalis.* This protozoan, which is ordinarily considered nonpathogenic, is frequently found in the vagina. It is found in a considerable proportion of all free vaginal discharges, but of course in less proportion when all gynecologic patients are checked. Schroeder and Loeser investigated the bacteriology of the vagina in over two thousand gynecologic patients, and found the *Trichomonas vaginalis* in only about 6 per cent. They felt, with previous observers, that the organism came from the intestinal tract. However, Blaud and Rakoff, in a study of two hundred women, concluded that vaginal trichomonads did not originate in the intestinal tract, though other types of trichomonads are found in the intestinal tract. Kessel and Gafford were unable to infect the vagina of women or of monkeys with *Trichomonas intestinalis.*

The vaginal type of trichomonads has been found in cervical secretions, in urine of both women and men, and in prostatic secretion and semen. Hees reported ascending *Trichomonas vaginalis* infection, and was able to culture it from endometrium, tubal contents, ovarian cysts, peritoneum, and blood stream of patients, and from viscera of a fetus and from semen. Schroeder and Loeser stated that in most cases of colpitis presenting a large number of trichomonads there is present also the *Micrococcus gazogenes alcalescens* which is responsible for the foamy character of the discharge. They concluded that the *Trichomonas vaginalis* is not essentially pathogenic and that its presence in large numbers in certain cases of vaginitis is simply incidental to the abnormal flora that favors its growth, hence they felt that the term ''trichomonas vaginitis'' was hardly justified. Most writers, however, favor retaining the term as expressive of an important clinical type of vaginitis characterized by the presence of large numbers of the *Trichomonas vaginalis* and subsiding when this organism is eliminated.

Pattyson, in a carefully controlled laboratory and clinical study of 250 cases of trichomonas vaginitis, states that ''the trichomonads are not dependent upon any coexisting organism to produce the symptoms seen in this condition'' and that ''enough conclusive

evidence has been presented by many investigators to prove beyond a doubt the patho-
genicity of the *Trichomonas vaginalis*." Later, Trussell and Plass confirmed this, using
pure cultures of the vaginal trichomonads.

Hibbert and Falls were able to produce clinical symptoms similar to those
seen in trichomonas vaginitis by inoculating four women with a culture of
Streptococcus subacidus.

These women developed immune reactions and were cured by a filtrate of a culture
of this streptococcus, administered subcutaneously and per vaginam. The colored plate in
their article shows an evident inflammatory reaction in the vaginal mucous membrane, but
none of the punctate hemorrhagic areas characteristic of trichomonas vaginitis. As men-
tioned later under Streptococcus Acidus Vaginitis, this streptococcus is apparently the
important factor in some cases of vaginitis just as the *Trichomonas vaginalis* is the impor-
tant factor in other cases, and it is possible that still other organisms will prove to be the
etiological factor in other cases as the large group of severe and persistent vaginal inflam-
mations are studied and different types identified.
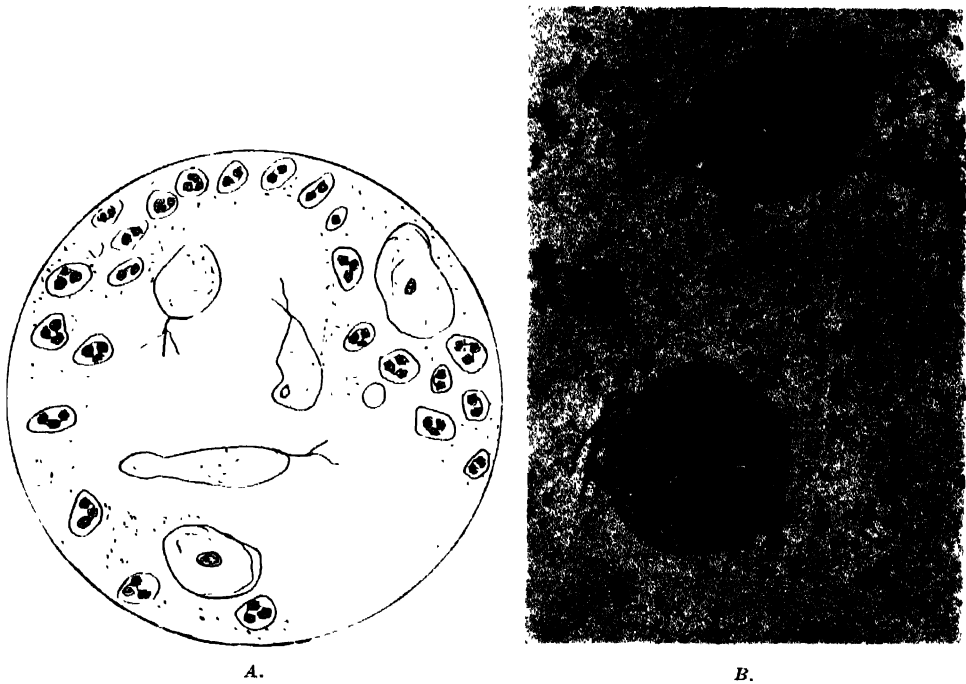
Fig. 366.—*A*, Composite field in a case of trichomonas vaginitis. Three of the organisms
stand out well in the center of the field. They are three or four times the size of the adjacent
pus cells. The flagellum moves rapidly sweeping particles into the ostium of the organism and
at the same time causing the organism to move forward, flagellum-end first. The two upper
trichomonads were in the same field, while the lower one was in the next field. The lower one
and the middle one varied much in shape while under observation. When moving rapidly, the
flagellum is not seen—only the resulting movement of the trichomonad or adjacent cells, as
mentioned in the text.

B, Human vaginal trichomonads. (Wagner and Hess—Zentralbl. f. Bakt., 1937.)

Symptoms and Diagnosis.—The patient complains of a constant free vag-
inal discharge, which is usually very irritating. The discharge persists despite
ordinary douching and often despite a prolonged course of local treatments,
and consequently the patient may be much discouraged as to prospect of cure.
Examination shows a yellow discharge, suggestive of gonorrhea but without
the distinct localization in the urethra or vulvovaginal glands or cervix. Spec-

ulum examination shows vaginitis, and if acute, usually small hemorrhagic spots may be seen as in the colored illustration, Fig. 338. The vaginal vault contains yellow discharge, which sometimes has some bubbles, giving a foamy character. Microscopic examination of smear eliminates gonorrhea.

The clinical characteristics mentioned and the elimination of the gonococcus indicate the probability of trichomonas vaginitis. The diagnosis is made by demonstrating the trichomonads (Fig. 366).

The presence of trichomonads in vaginal discharge may be easily and quickly ascertained by microscopic examination of a warm spread. A drop of warm water is placed on a slide, a bit of the discharge mixed with it, a cover-slip placed over, and the specimen examined before it becomes chilled.

LIFE CYCLE OF VAGINAL EPITHELIUM
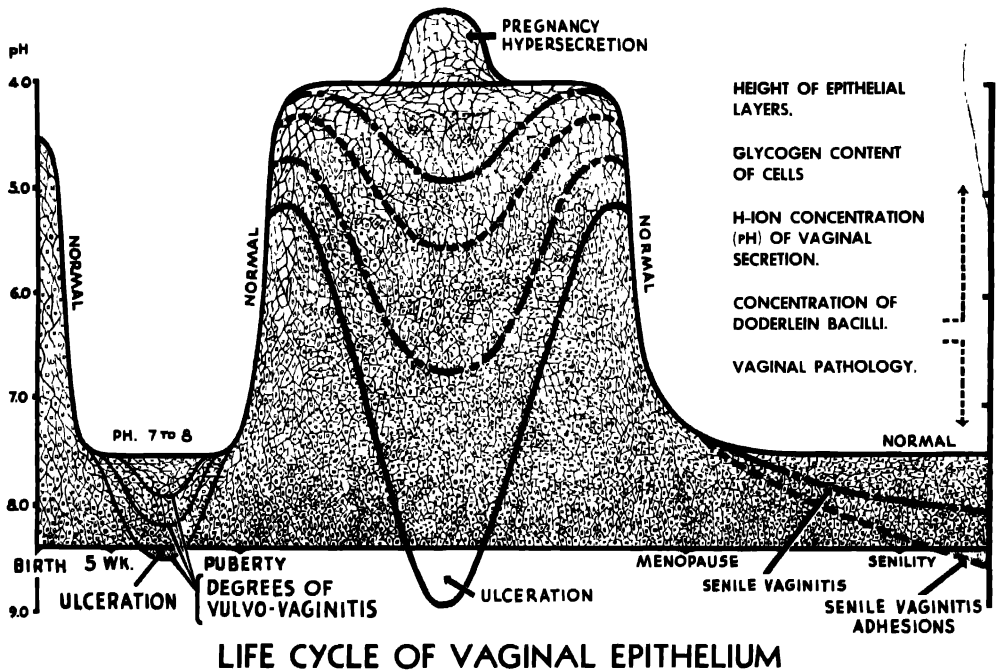
Fig. 367.—Life cycle of vaginal epithelium. (Karnaky—*Medical Record and Annals.*)

Examined with the light stopped down to show outlines, the field contains pus cells, vaginal cells, and debris. At a thin spot in the field an irregular movement of pus cells and debris may be noticed. This movement is produced by the waving action of the slender flagellum of a trichomonad, and further examination will show the dim outline of the protozoon, as indicated in Fig. 366, *A*. The outline may be traced by focusing slowly up and down the cell.

In some cases the trichomonads may be active and move about the field, while in other cases they are motionless except for the flagellum. Because of its thinness and movement the flagellum is not seen, its presence being indicated only by the movement of adjacent debris. When the patient has been taking douches the trichomonads may be inactive, their presence being indicated only by suspicious forms. If such a specimen be left on the microscope stage with the light on for several minutes, the warmth may revive the trichomonads so that identifying movement of debris may be seen.

Details of structure of the trichomonad may be demonstrated by staining. Of course dead trichomonads, stained or unstained, have the spherical shape of the resting or dead single-cell organism, as shown in Fig. 366, *B*.

The pH of the vaginal contents is shifted markedly toward alkalinity in vaginitis, and this in turn favors additional growth of the pathogenic organisms. With these conditions, the thickness of the protecting epithelium is seriously diminished, as shown by the lines for vaginitis and ulceration in Fig. 367.

Another point in the pathology and diagnosis is that the *Bodo urinaris* (Fig. 368) is present at times in vaginal discharge, and may be mistaken for the *Trichomonas vaginalis*. In a doubtful case special staining will bring out the differences, as in Fig. 368.

Treatment. Numerous articles have appeared dealing with the treatment and other phases of this interesting subject. Karnaky conducted extensive cultural investigations of the various trichomonads and other organisms associated with vaginal inflammation. Davis reported a helpful series of experiments determining the trichomonad-killing power of practically all the common vaginal applications and douches.

Fig. 368.—Showing the differences between the *Trichomonas vaginalis* and the *Bodo urinaris*. A, *Trichomonas vaginalis*. B, *Bodourinaris*. (Karnaky—Urol. and Cutan. Rev.)

Important in connection with treatment are the extensive investigations made to determine the normal content of the vagina at different ages and the factors which keep it in normal condition. The fundamental work of Cruickshank and Sharman on vaginal acidity and the many other helpful studies on various ramifications of the subject as indicated in the reference list, have brought out the following items of information:

1. In the age of ovarian activity (puberty to climacteric) the normal vaginal contents have a decided acid reaction. This acid reaction is due to the activity of acid-forming bacilli (Döderlein bacillus), and it is ordinarily maintained at such concentration that only acid-resistant bacteria can propagate. This forms a defense-mechanism against pus bacteria, which multiply in neutral or alkaline media, and is usually effective against ordinary moderate contaminations. The activity of the acid-forming bacilli depends on the glycogen content of the vaginal epithelial cells. This normal glycogen content of the vaginal cells is due to the estrogenic activity of the ovaries, and is absent in childhood and after the climacteric. Consequently, in those periods the acid-forming bacilli do not flourish, the contents become alkaline, and even slight contamination often results in prolonged vaginitis (persistent vaginitis of childhood, troublesome and recurrent atrophic or ''senile'' vaginitis).

2. When the vagina becomes inflamed the normal supply of glycogen in the cells is diminished, the acid-forming bacilli die off, the contents shift toward alkaline reaction, and pus bacteria multiply rapidly and dominate the picture. As the acid hydrogen-ion content diminishes, the pH rises, producing first diminished acidity and finally distinct alkalinity of the discharge. The chemical and bacteriological work has progressed sufficiently to permit correlation of the pH (tendency toward alkalinity) with the growth of various pathological organisms. In round numbers, pH 3 to 4 is normal for the vaginal contents, and at pH 5 to 6 trichomonads and monilia flourish. This increases the tendency toward alkalinity and opens the way to pus bacteria (staphylococci, streptococci, *B. coli*) which grow especially well at pH 6 to 8. At pH 7 the discharge becomes neutral, and beyond that it is distinctly alkaline. In this connection, see Fig. 250.

3. For the cure of vaginal inflammation (trichomonas or other type) restoration of growth of the normal acid-forming bacilli is necessary. With ordinary inflammation, the killing of the pus bacteria with antiseptic douches may be all that is needed to initiate a chain of events leading to recovery. But when the inflammation is complicated by trichomonas infestation its eradication requires more aid to the acid-forming bacilli, such as acid-forming material (glucose, glycogen, etc.) for them to work on. If this additional aid is given for a sufficient length of time, the damaged vaginal mucosa gradually recovers and its cells again supply the required glycogen for maintaining the normal acid-bacillus protection.

4. The treatment of trichomonas vaginitis requires (1) acidifying of the vaginal contents to discourage the growth of pus bacteria and trichomonads and (2) supplying of material for the acid-forming bacilli to utilize in their growth until the vaginal cells recuperate sufficiently to furnish again the normal supply of glycogen. The first objective is attained by giving vinegar douches (three tablespoons of a good grade of white vinegar to two quarts of warm water) or lactic acid douches, once or twice daily, depending on the severity of the discharge, and then less frequently as the discharge diminishes. A convenient prescription is as follows:

> ℞ Lactic Acid. U. S. P. 1 lb.
> Sig.: For local use only. One teaspoonful to two quarts
>   of warm water. Use as directed.

The second objective is attained by the frequent introduction of suitable carbohydrate material (glucose, glycogen) into the vagina. Manufacturers now supply such material in tablets, which usually contain also some antiseptic to aid in diminishing pathologic bacteria. Reliable pharmaceutical firms have given much aid to the profession by their prompt utilization of the scientific investigations above mentioned and the supplying of required materials in convenient form for clinical use. Such tablets may be prescribed under the various trade names, for example, Floraquin tablets (Searle & Co.) or Devegan tablets (Winthrop Chemical Co.).

As to general directions, the patient inserts one or two tablets into the vaginal vault once or twice daily, the number of tablets and frequency of introduction depending on the severity of the process and diminishing as it subsides. The manufacturer gives detailed directions for his product, and it is well to get full information concerning the one used. In acute cases, the ordinary soothing applications used in office treatment also help in relieving discomfort. When traveling or other circumstances make douches impracticable or undesirable, the tablets may be used alone—douches being omitted or used only when the discharge is irritating.

5. The bloody menstrual flow lowers the acidity of the vagina and hence there is a tendency to recrudescence of trichomonas or other inflammation at that time. Consequently the acid treatment with douches and tablets should be continued during menstruation. If the douche taken once daily is just comfortably warm, it should have no influence in increasing or diminishing the normal menstrual flow. This alkaline tendency during menstruation, with resulting increase in activity of any remaining trichomonads, is utilized in testing for cure. When it is thought a cure has been effected, have the patient stop all treatment at the onset

of menstruation and then come a few days after cessation of the flow for check-up as to clinical and microscopic evidence of trichomonads, having taken no douche in the meantime.

6. Urethritis in the husband is occasionally caused by trichomonas vaginitis and the accompanying free growth of pus bacteria. This may lead to suspicion of gonorrhea and an embarrassing family situation. The diagnostic elimination of gonorrhea is complicated by the fact that the *Micrococcus catarrhalis* is also gram-negative and intracellular. In one such case, in which a diagnosis of gonorrhea had already been returned by a laboratory on the strength of gram-negative intracellular cocci without inquiry as to clinical findings, we were able clearly to exclude gonorrhea by correlation of clinical findings and additional laboratory work including cultures and complement-fixation tests covering both husband and wife. Nitschke presented an instructive article on trichomonas infestation in the male.

Some prefer powders, and various kinds have been used. Karnaky in his earlier work employed a mixture of cornstarch, glucose, and boric acid, and later advised the addition of iodine to inhibit the growth of fungi in association with trichomonads. Adair and Hesseltine use a mixture containing lactose 95 per cent and citric acid 5 per cent. Roblee finds beta lactose the most satisfactory. In office treatments, the vagina is cleansed (with a 50 per cent solution of green soap, if preferred and not too irritating and uncomfortable) and then the selected powder is blown into the vagina or packed in with a spatula. Directions are then given for continuing the treatment at home. For home use the selected powder is put in large capsules (veterinary capsules, of which there are two of convenient size—No. 12 (70 grains) and No. 11 (120 grains). The patient is instructed to take the lactic acid douche at night and then insert the carbohydrate capsule to the top of the vagina, and to repeat this daily.

There are other successful methods of managing this troublesome form of vaginitis. Most of them are dependent for their effect upon protozoacides, such as carbarsone, picric acid compounds, quinine derivatives, acetarsone, aldarsone, cinquarsen negatan, and vioform. The picrate method reported by Buxton and Shelanski was successful in 97 per cent of their cases.

There is a great difference in cases as to how they respond to treatment, suggesting marked difference in the trichomonads or in the susceptibility of patients. Some yield quickly to a simple plan of treatment while others require prolonged care and strict handling, with special medication. The erratic and apparently unreasonable way in which some cases persist means, of course, that there is some unknown factor in the problem or perhaps several of them. In these resistant cases the elimination of trichomonads seems to depend on careful study and individual management, to eliminate harboring sites in the genital canal, e.g., in cervix or Skene's glands or vulvovaginal glands or in the husband. There is also the question of individual susceptibility and the possibility of diminishing that by general treatment, including the internal administration of antiprotozoal remedies. In persistent cases the bladder and rectum must be eliminated as sources of infection. The treatment of bladder infection recommended by Visher is 15 c.c. of 1 per cent mercurochrome instillations. For rectal infection, Drabkin advises 2 gr. carbarsone rectal suppositories, preceded by cleansing enemas, twice daily for a week and then every other night for two weeks.

Streptococcus Subacidus Vaginitis

Hibbert and Falls present an instructive study of the *Streptococcus subacidus* as a cause of vaginitis, and perhaps a large factor in many cases of vaginitis associated with trichomonads. They employ a vaccine made from this germ in treatment. They were able to show this gram-positive coccus in profuse growth in vaginal discharge before treatment, and the absence of pathogenic bacteria and the presence of the normal Döderlein bacilli after successful treatment. From their investigations they reach the following conclusions:

1. The *Streptococcus subacidus* found in patients presenting the clinical picture of *Trichomonas vaginalis* vaginitis is pathogenic, as shown by its fulfillment of Koch's laws.

2. It produces an immune reaction (agglutination) when injected intradermally.

3. Local clinical improvement was more rapid and apparently more lasting when general antibody reaction was stimulated by the vaccine in addition to the local antibody stimulation by the filtrate.

4. The pH of the vagina was found to be relatively high when there were large numbers of *Streptococci subacidus* present, and to be lower as they disappeared, irrespective of the presence or absence of the trichomonads.

5. The disappearance of the clinical picture and symptoms with the disappearance of the *Streptococcus subacidus*, occurring in the presence of the trichomonads, suggests the former as the chief factor in the production of the lesions.

6. Further efforts to eradicate this streptococcus from the genital tract, and to raise the general immunity to this organism, seem the logical way to attempt the control of this infestation.

Other Animal Parasites

There are other parasites of the ameba type which occasionally cause trouble in the vagina. These are the *Ameba urogenitalis*, which invades the bladder, causing hematuria, and the *Distoma hematobium* which also infests the urinary tract. The latter is found in a large percentage of Egyptian women. It may propagate in the vulvar epidermis and cause condylomas. It may cause chronic inflammation of the vaginal wall with infiltration, while on the cervix uteri the papillary outgrowths from it may resemble carcinoma.

MONILIA VAGINITIS

Monilia vaginitis is the term applied to inflammation of the vagina caused by various yeast fungi. It is known also as "aphthous vaginitis" and by other terms. The infection is carried to the genitals usually by the fingers of the patient, who has been handling some organic substance on which the fungus was growing. A mother whose baby is suffering with thrush may infect herself. It usually occurs in nursing women or in pregnant women or in cases of prolapsus uteri. It is said to occur sometimes as the result of sexual intercourse with a diabetic husband.

The pathologic changes are practically the same as in thrush in the mouth. There are white patches, representing the growing fungus, and accompanying inflammation of the adjacent tissues. The patient complains of burning, itching or smarting, but there is not much discharge. In the examination through the speculum, the vaginal wall presents the ordinary evidences of inflammation

and in addition it is studded with small white patches about the size of a pin-head. In some cases small ulcers may form. A scraping from one of the white patches, examined with a microscope, will show the fungus mycelium stalks and buds (Fig. 350). To prepare the scraping for microscopic examination, put it on a slide, add a drop of a 10 per cent solution of potassium hydroxide, put on a cover glass and examine, dimming the light so as to visualize outlines. If scanty, however, the fungus may be missed in this hasty method. So it is advisable to make the regular staining of a specimen of the discharge, so that any monilia elements present will show clearly. The ordinary methylene blue stain used for gonococci and other bacteria will bring out monilia if present. The monilia elements are gram-positive and hence will show in specimens in which gonococci are decolorized. In doubtful cases of suspected monilia infection, culture on Sabouraud's media will settle the matter.

Monilia should be suspected in any case of vaginitis without other evident cause, particularly if there is persistent or recurring burning and itching and still the pH shows normal vaginal acidity. This is one of the vaginal pathogenic organisms which grows well in an acid medium. It is a frequent accompaniment of diabetic vulvitis. It should be suspected also in cases where coitus causes burning and discomfort in husband and wife for a day or two without disturbance at other times.

Plass, Hesseltine and Borts, in their instructive article, give the following conclusions from their extensive study:

1. Monilia are frequently present in the vaginal secretions of patients suffering from vulgovaginitis, and appear to be concerned directly with the etiology of the clinical condition, although normal individuals may harbor the fungi for long periods without showing vaginal irritation.

2. Pregnancy and diabetes are definite predisposing factors, and menstruation may be, since sexually active women are more prone to the infection. Parous women are more often infected, but children, virginal adults, and senile women may likewise show the organisms. In the majority of instances the mode of infection cannot be demonstrated. High acidity of the secretion favors the growth of monilia, but is not essential.

3. The chief symptoms of the infection are itching, burning, and smarting of the lower vagina and vulva. Digital and speculum examinations, and coitus are painful. A profuse leucorrhea rarely appears, and only occasionally is the secretion characteristic, when it contains small white flakes of thrush-like material. Varying degrees of vaginitis are encountered, with, occasionally, the appearance of vaginal or cervical thrush. Complications are rare.

4. Monilia vaginitis tends to undergo spontaneous relief, but occasionally becomes chronic and may produce recurrent irritation over a period of months or years. Delivery usually leads to complete relief in pregnant women, while menstruation generally has the same effect temporarily in the nonpregnant.

5. Gentian violet, in one per cent aqueous solution, applied locally affords the best method of treatment. Alkaline douches may be of some value.

6. Monilia vaginitis in pregnant women is a definite source of infection in sporadic outbreaks of oral thrush in the newborn.

Treatment.—In monilia vaginitis, gentian violet applications are made in the office treatment—1 per cent aqueous solution for the mild cases and 5 per cent in 50 per cent alcohol for the resistant ones.

ATROPHIC VAGINITIS

Atrophic vaginitis occurs almost exclusively in women past the menopause, hence the term "senile vaginitis," by which it is at times designated. There is considerable destruction of the covering epithelium, and such denuded areas may unite by adhesions, hence the designation "adhesive vaginitis."

The predisposing cause is the thinning of the protective vaginal epithelium from the diminishing estrogenic hormonal influences. The variations in the thickness of this epithelium at different ages, along with the characteristics of the corresponding vaginal smears, are well shown in Figs. 369 and 370. As mentioned later, vitamin E deficiency is a factor in some cases and vitamin A deficiency in others.

The exciting cause is probably a slight uterine discharge, which macerates the vaginal epithelium and favors bacterial growth. A certain amount of atrophic vaginitis is very frequent and often produces no symptoms. In fact, it is probable that a considerable proportion of women over sixty have some of this disturbance, with slight adhesions here and there.

Over irregular patches the superficial layers of epithelium are thrown off (Fig. 371, A), forming erosions from which there is a scanty secretion. The eroded areas are tender and usually bleed on manipulation. When such areas develop on opposed surfaces of the vaginal walls adhesions take place between them. For a long time the adhesions are weak and the surfaces may be easily separated. If the process of adhesion is allowed to go on undisturbed, the adhesions become organized and firm (Figs. 371, B, 371, C), and in the course of time may become so extensive and strong that the vagina is practically obliterated. Atrophic vaginitis is accompanied by a slight "gluey" discharge, small in amount but irritating.

The **symptoms** are vaginal discharge, sometimes bloody, with some pain in the pelvis and vaginal burning and discomfort. There may be some burning or smarting on urination, from irritation of the vulva by the discharge.

On digital examination, the vaginal walls may be adherent in places, especially at the upper portion of the vagina, and the separation of the walls causes some pain and bleeding. Examination of the vagina through the speculum shows hemorrhagic areas of denudation and inflammation, principally in the upper part of the vagina.

Diagnosis.—The evidence of subacute vaginitis with marked tendency to adhesion of the walls in spots establishes the diagnosis of atrophic vaginitis. Vaginitis occurring after the menopause is usually of this form. Be careful to distinguish gonorrheal vaginitis which may complicate the atrophic form, as may also trichomonas and monilia vaginitis. Serious disease of the uterus causing discharge, particularly cancer, must be excluded.

Treatment.—If the trouble is slight and causes no symptoms, it needs no treatment. The adhesions in themselves cause no trouble and consequently need no treatment, except when they become so extensive as to interfere with coitus.
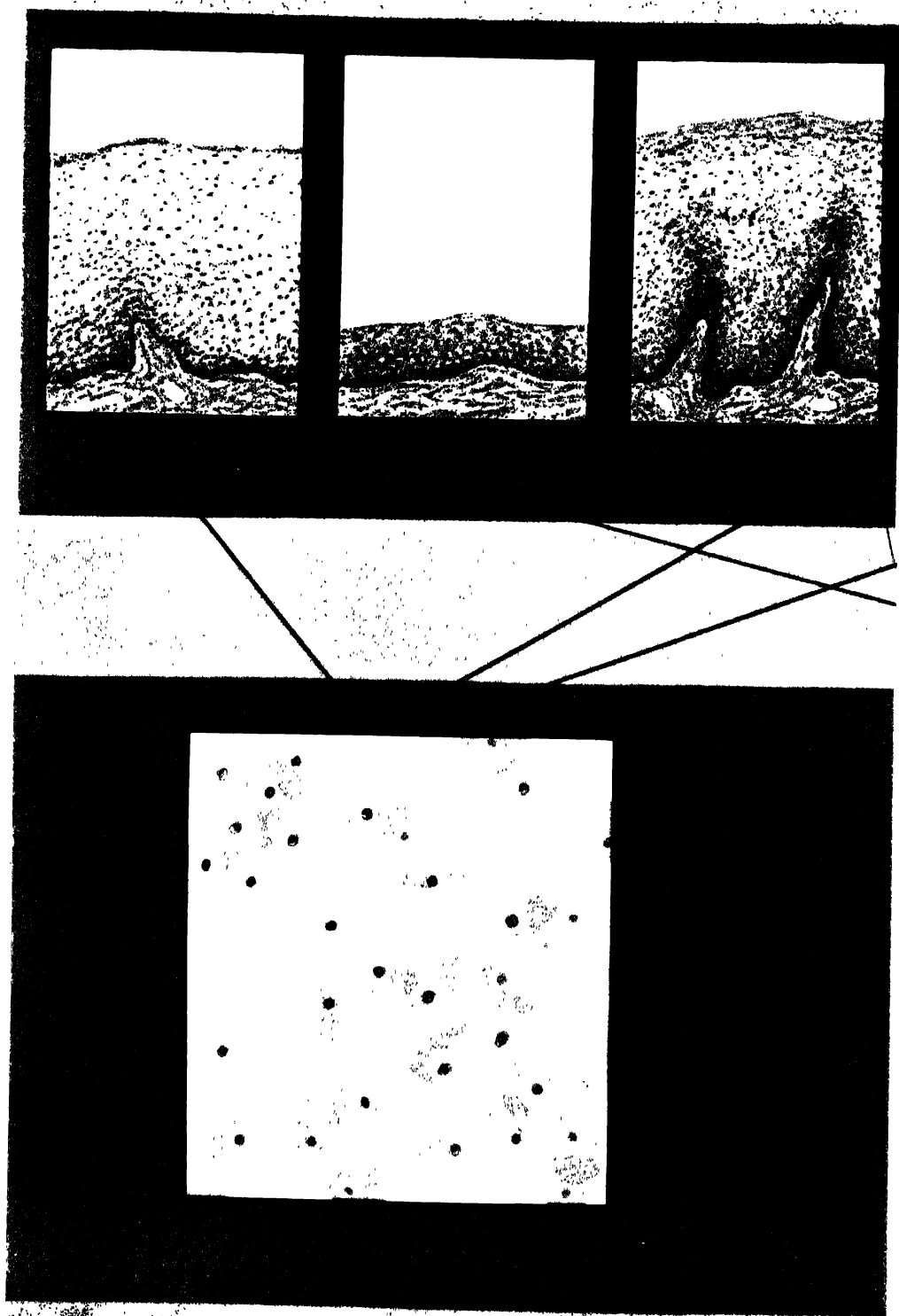
Fig. 369.—Estrogen effects on the vaginal mucosa at different ages. (Netter—Ciba Pharmaceutical Products, Inc.)
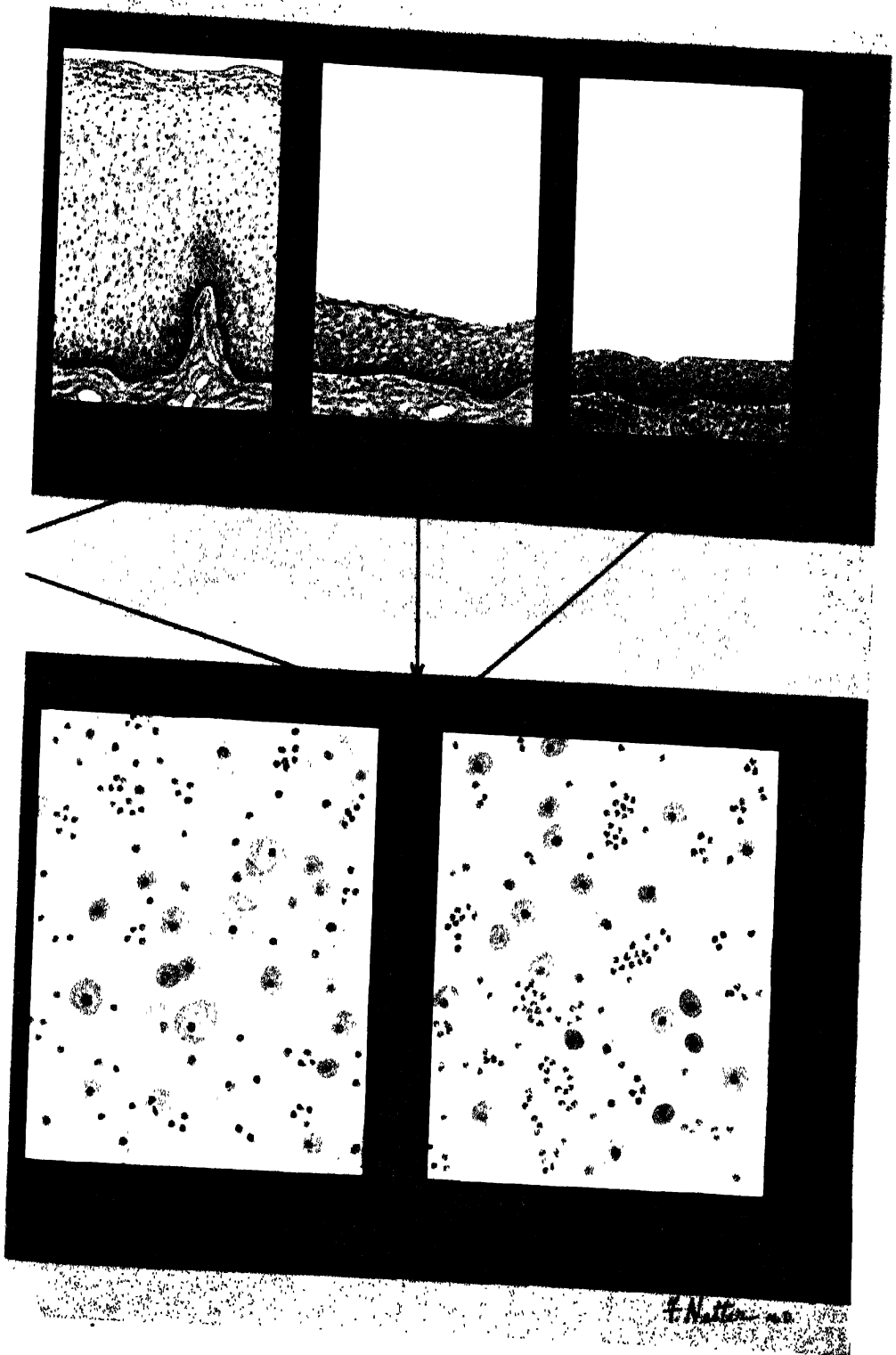
Fig. 370.—Estrogen deficiency effects on the vaginal mucosa and the vaginal smear in the climacteric. (Netter—Ciba Pharmaceutical Products, Inc.)

When there is persistent irritation, giving rise to an irritating discharge or bleeding, or pain, then the following treatment is indicated:

1. Put the patient in the best possible general health.

2. Keep the vagina free from the irritating discharge by the use of a lactic acid douche, which favors the growth of the normal vaginal flora. At
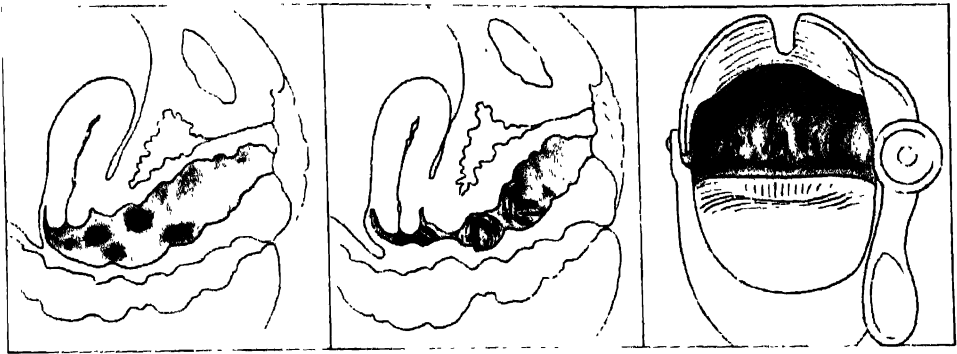
A.   *B.*   *C.*

Fig. 371.—Atrophic (senile) vaginitis. *A*, indicating scattered areas of adhesive vaginitis; *B*, adhesions resulting later from adhesive vaginitis; *C*, appearance of adhesions through the speculum.
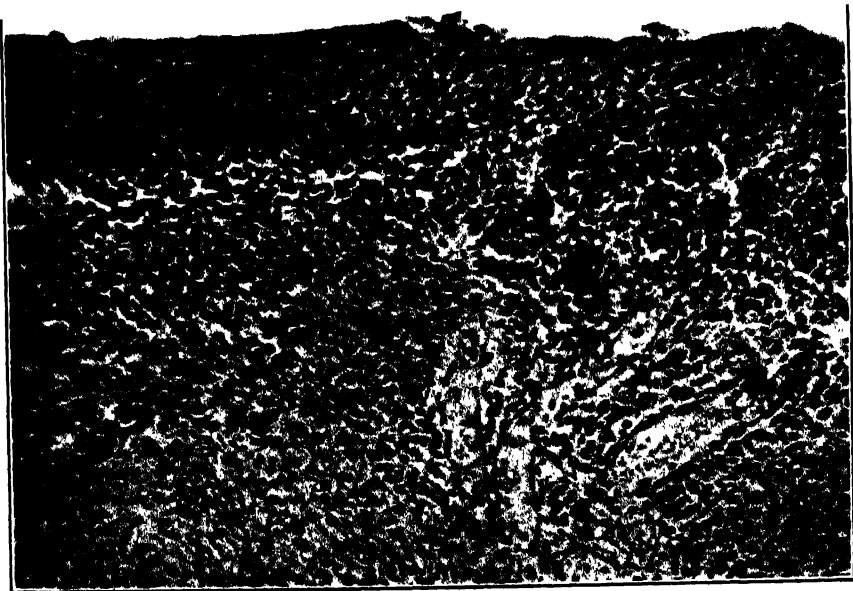
Fig. 372.—The atrophic squamous epithelium merges indefinitely with the subepithelial tissue. The basal layer of cells is irregular and moth-eaten in appearance. A dense infiltration of inflammatory cells, consisting chiefly of round cells, can be seen beneath the squamous epithelium. All microphotographs (Figs. 372-374) were magnified 100 times for accurate comparison of the squamous epithelium. (M. Edward Davis—*Surg., Gynec. and Obst.*)

office treatment, make application of soothing solution to relieve surface discomfort, such as 10 per cent argyrol.

3. The special treatment advisable depends somewhat on the type of case, that is, whether ovarian hormone deficiency or vitamin E deficiency or vitamin A deficiency predominates.

Ovarian Hormone Deficiency Type. These patients often have general climacteric disturbances for which they are receiving endocrine treatment, and this may help the atrophic vaginitis. For local effect in building up a protective epithelial covering, however, administration of some potent estrogenic preparation by vaginal suppositories also is advisable.
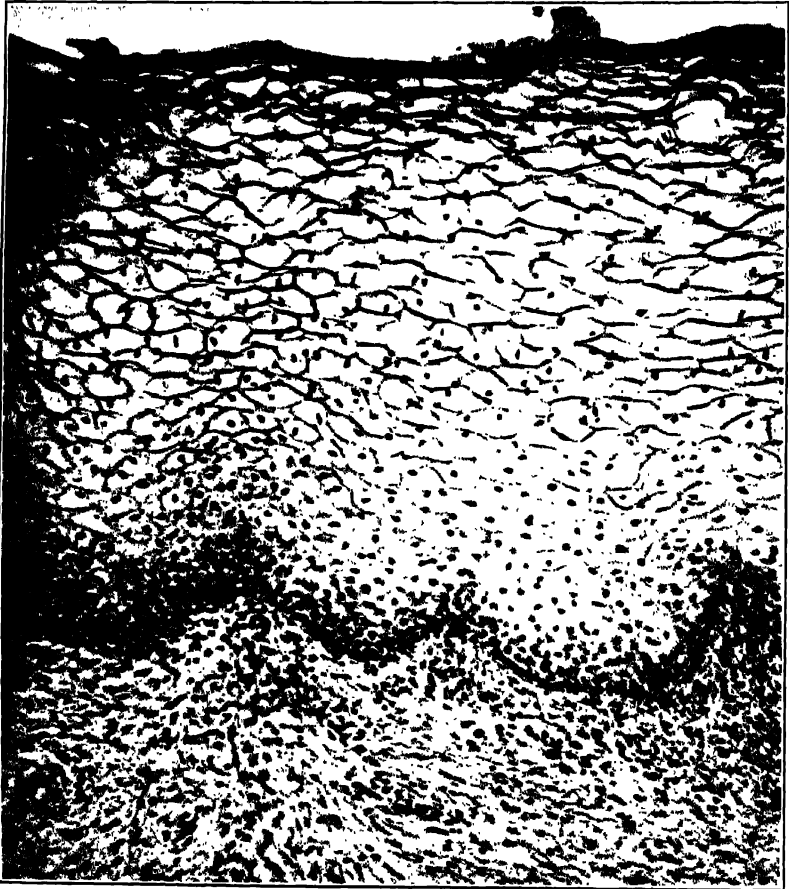
Fig. 373.—After four weeks' treatment. The squamous layer has been rebuilt to several times the previous thickness. The basal layer of cells is arranged regularly and shows signs of activity. The large clear cells of the basalis contain an abundance of glycogen. (M. Edward Davis—*Surg., Gynec. and Obst.*)

M. Edward Davis studied a series of cases of atrophic vaginitis treated with the estrogenic hormone. The results were very carefully checked by excision of specimens of the vaginal mucosa at various stages in the treatment, and the photomicrographs shown in Figs. 372 to 374, are from his paper. The typical conditions found in atrophic vaginitis are shown in Fig. 372. This and the two succeeding photomicrographs are from the same patient, aged sixty-five years. The effect of four weeks of treatment is shown in Fig. 373. For accurate comparison, the magnification is the same. A later stage of the treat-

ment is shown in Fig. 374. This latter photomicrograph facilitates detailed study of the arrangement and individual characteristics of the new epithelial cells. Quoting from the article, the details of treatment were as follows:

The cases were divided into several groups, according to the types of treatment. The largest group received 100 rat units of amniotin (Squibb) subcutaneously three times weekly. In addition to this, a vaginal suppository containing 75 rat units of
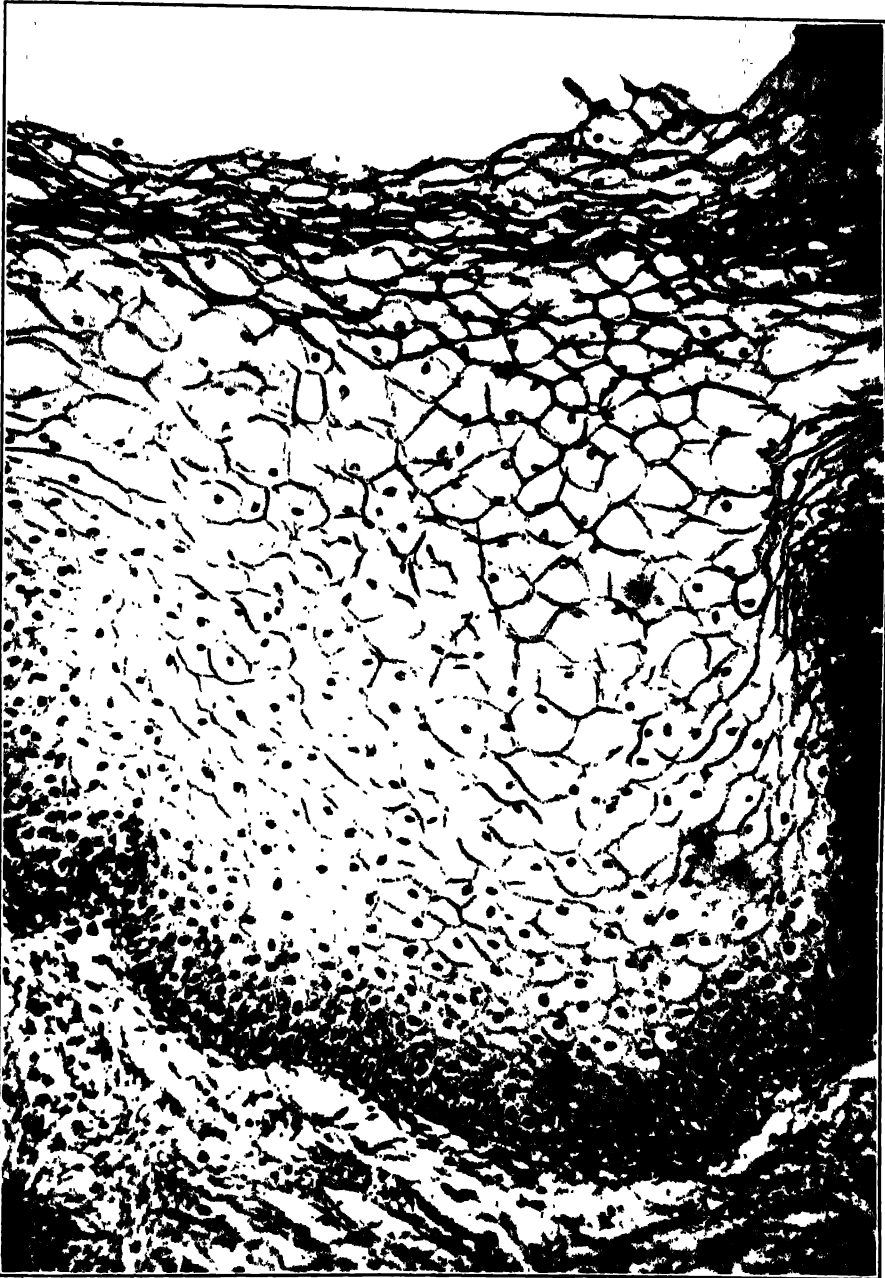
Fig. 374.—Under continued treatment an increasing thickness of the squamous epithelium can be seen. The individual cells have increased in size. A well-developed functionalis is now apparent. The interepithelial zone of cornification likewise can be noted. (M. Edward Davis—*Surg., Gynec. and Obst.*)

amniotin was used each night. The duration of the treatment averaged six weeks, although in most instances the symptoms disappeared after the first ten days. A second group of patients received only subcutaneous injections of 100 rat units of amniotin. This was done to eliminate the effect of the inert ingredients of the suppositories as an important factor in the therapy. The last group of women received only suppositories. These patients responded very poorly, so the subcutaneous administration of amniotin was added to the therapy.

The small amount of estrogenic substance required for a complete restoration of the normal mucosa and the rapidity of action was a distinct surprise. The marked responses of the atrophic epithelium to the dosage used made the present therapy easy and entirely feasible.

The changes in the vaginal mucosa as a result of treatment with estrogenic substance are indeed interesting. The inactive basal cells rapidly begin to proliferate, and abundant mitoses can be seen in them. The number of cells in the basalis rapidly increases. They exhibit all the signs of active growth. Under continued stimulation the basalis develops a good functional layer and the typical zone of intraepithelial cornification can be seen. The cells soon contain an abundance of glycogen. The inflammatory foci beneath the squamous epithelium, usually seen in senile vaginitis, disappear. A marked increase in the vascularity of the submucosa likewise occurs. All of these striking changes can be followed accurately in the photomicrographs which are all of the same magnification, so that proper comparisons may be made.

The patients show improvement within a few days after treatment, and in most instances their symptoms have all disappeared in about ten days. A general feeling of well being is usually present and some of the elderly women insist that they feel better than they have for years. Grossly, the changes are quite apparent. The mucosa becomes somewhat velvety, more elastic, and more distensible. All signs of inflammation and irritation disappear. Petechial hemorrhages, superficial ulcerations, and filmy adhesions likewise disappear and

These changes, however, are not permanent. Several weeks after the cessation of treatment the mucosa rapidly returns to its previous atrophic condition. Within four to six weeks the usual mucosa is again present. However, the patient's symptoms do not return unless she has not received enough treatments and some inflammation still remains. If she has been treated for a sufficiently long time so that the mucosa has healed completely and all subepithelial inflammation has disappeared, then the symptoms do not return until the factors which produce senile vaginitis again are present. If trauma and infection are again introduced, senile vaginitis will undoubtedly recur. In our series it was found that the patients should be treated for a period of four to six weeks. The patients with marked changes should be treated for six to eight weeks. In all of our cases the results were good, the symptoms all disappeared and remained cleared up for at least six months, during which time the patients were carefully followed. This sequence of events demonstrates conclusively that the physiologic changes in the vaginal mucosa in themselves do not produce symptoms. If trauma and infection are introduced, senile vaginitis develops.

In some of our cases the patients were treated for trichomonas vaginitis for a considerable length of time. These were the most stubborn and difficult cases because they did not respond to the usual therapy for this condition. A few of these cases were treated with estrogenic substance and, to our surprise, they cleared up rather promptly.

The results of estrogenic therapy in atrophic vaginitis may be followed and checked by vaginal smears, as explained under Ovarian Hormone Therapy in Chapter III. If the estrogenic hormones are not available or the expense prohibits their use, the carbohydrate treatment outlined under trichomonas vaginitis may be used; the results, however, are not as prompt nor as certain.

Vitamin E Deficiency or Excess Estrogen Type.—Notes concerning this type and the vitamin A deficiency type are quoted from Robert J. Crossen's contribution to the three-volume work *Modern Medical Therapy in General Practice*, by Barr (Williams & Wilkins Company).

Shute described a type of senile or atrophic vaginitis which he attributed to an excess of estrogenic substances in the circulating blood. That estrogenic activity should still be apparent after the menopause at first seems paradoxical. Salmon and Frank, however, using the vaginal smear method, found 60 per cent of a group which included twenty-four surgical castrates, ten women during natural menopause, and eleven who had had a sterilization dose of deep roentgen ray, still positive for estrogen. Shute studied the estrin level in women who suffered from vaginitis following the menopause and found that, in those who were not relieved or were made worse by administration of estrogenic substances, there was either a constant excess of estrogen in the blood or a true estrus cycle. Since this type of vaginitis gives the same symptoms and findings as the other two types it can only be differentiated from them by hormone studies and the failure to improve on the estrogenic therapy.

The problem in these cases was to find something which would counteract the excess estrogen in the blood. Shute had previously shown that vitamin E was effective in preventing threatened abortion because of its neutralizing action on the estrogenic antiproteolytic substance found in the blood serum of such cases. In these cases it was found that there was a wide variation in the amount of vitamin E needed to neutralize the estrogenic factor; this was later found to be true in the cases of atrophic vaginitis. The majority of the cases in Shute's series were controlled on the following regime. During the first twenty-four hours three doses of 15 c.c. of cold-pressed wheat germ oil were given to insure the neutralization of excess of the estrogenic substance in the circulating blood, and this was followed by 4 c.c. a day as a maintenance dose until the vaginitis was improved. In one of his cases 45 c.c. was needed daily for five days to effect a cure. Shute states that he has given many patients 20 c.c. daily for several months without ill effects, and one of his patients took an ounce daily for two months. Shute found that wheat germ oil, in bulk or in capsules, retains reliable potency for about eight weeks; this time is shortened unless the oil is kept cool. It is important, therefore, in using oil to make certain that it is fresh when purchased and is kept cool until used.

A concentrate of the unsaponifiable matter from wheat germ oil in a vegetable oil is on the market under the trade name of Germol E (Ayerst-McKenna). The glycerides, which because of their tendency to become oxidized probably account for the instability of the oil, are removed and the concentrate represents about ten times the concentration of the oil from which it is made. Tests made by this company showed that the capsules retained their full potency for at least a year.

An idiosyncrasy to wheat germ oil was noted by Shute in six patients and was characterized by a rash, urticaria, gastro-intestinal symptoms, or a sensation of heat. Patients who are known to be sensitive to wheat should be carefully controlled if it becomes necessary to give them Vitamin E therapy.

Vitamin A Deficiency Type.—This type which was described by Simpson and Mason has symptoms and signs similar to the types of vaginitis described above. These workers in a study of fifty patients suffering from atrophic vaginitis found that their diets were low in vitamin A. Also in some of the patients the absorption of vitamin A was impaired because of chronic digestive disturbances or the habitual use of mineral oil.

The patients in this series were given cod liver oil 16 c.c. three times daily for a week and then 4 c.c. daily until cured. Three-fourths of the patients followed were symptom-free by the end of the second month of treatment and in only one instance did the symptoms continue as long as four months after therapy was begun. Vaginal studies made on some of the patients showed that as the symptoms improved, there was a rapid repair of the vaginal epithelium.

ULCERATIVE DISEASES
of Vulva and Vagina

The ulcerative diseases include simple ulcer, chancroid, syphilis, tuberculosis, granuloma inguinale, lymphogranuloma inguinale, and rarer ulcerations.

Simple Ulcer
of Vulva and Vagina

A simple ulcer is an area of ulceration due to simple irritation or inflammation. A pessary or other foreign body may cause simple ulceration, if long in place without care, as may also infection at any point with ordinary pus germs.

The diagnosis of ulceration presents no difficulty, as it is established by finding an area devoid of epithelial covering presenting a granulating surface. An eroded area on the vulva or in the vagina, which is sensitive and bleeds easily, may be mistaken for an ulcer, but close inspection will show that the surface is still covered with a thin layer of epithelium. The diagnosis of simple ulcer is made by excluding the special types of ulceration, the characteristics of which will be found under each special disease.

As to treatment, removal of the cause and the use of a simple cleansing wash or douche will take care of a simple ulcer. Sometimes the cause is general instead of local. Endocrine or vitamin deficiency may be a factor. Kreis reported a persistent ulcer in a sixty-four-year-old patient with bloody vaginal discharge from it. A specimen showed that it was not malignant nor from any of the granulomas. He treated it for six months, including cauterization, without healing. He then gave estrin treatment by injection and by mouth. Bleeding ceased and the ulcer disappeared. Two years have elapsed with no return of the ulcer. Estrin was evidently needed for epithelization over the denuded area. Reifferscheid calls attention to the increased rapidity of healing secured by estrogenic therapy in the chronic ulcers in the vagina in aged patients, usually associated with prolapse. Those formerly requiring treatment for ten to fifteen weeks now heal, under local estrogenic treatment, in two to three weeks, and he reported thirty cases under intramuscular injections of estradiol benzoate in which healing occurred in an average of eight days. The injections were given at four- to five-day intervals. No local applications were used, but tampons were employed to correct uterine prolapse.

We recall a case without prolapse in which a persistent ulcer at the vaginal vault causing bloody discharge in an aged patient was cleared by treatment with estrogenic vaginal suppositories. In such an ulcer carcinoma must of course be definitely excluded, and then if it does not clear promptly under local and oral estrogenic therapy it would be well to employ intramuscular administration of a potent preparation. Following radiation treatment for cancer, the estrogenic-deficiency type of ulcer may appear and require estrogenic treatment. It is possible that epithelization of chronic ulcers in other locations in the estrogen-deficient patient may be aided by estrogenic therapy.

Chancroid
of Vulva and Vagina

Chancroid (Fig. 375) is an infectious ulcer, entirely local in its effects and due to inoculation with secretion from another chancroid. It is known also as "soft chancre" and as "soft sore." It constitutes one of the three so-called "venereal diseases" (gonorrhea, chancroid, syphilis).

It is due to a specific infectious agent which causes chancroid and nothing else. It is invariably due to contact with virus from another chancroid, and sexual intercourse is nearly always responsible for this contact.

The infectious principle of chancroid is much more exclusively conveyed by sexual intercourse than is syphilis. Conversely, chancroidal virus is much less liable than syphilitic virus to be conveyed in an active state simply by contaminated articles. However, such method of conveyance is probably possible and must be guarded against. The chancroidal virus does not penetrate healthy epithelium but makes its entrance through a crack or abrasion.

The infectious agent is a short bacillus, discovered by Ducrey and hence designated as the **Ducrey bacillus**. It occurs in the discharge, but may be somewhat difficult to identify because of contaminating material.

In the case of enlarged glands, the **serum** secured by puncture with a large hollow needle will usually show the bacillus.

Within twenty-four to forty-eight hours after infection, there appears a small pustule on an inflammatory base. This point of infection may be situated at any part of the external genitals or in the vagina. This beginning lesion may not be noticed by the patient, so that according to her statement the lesion may not have appeared for several days or a week after coitus. In a short time the epithelial covering over the infected spot is lost and a small ulcer is thus formed. This ulcer has sharp, punched-out margins, a rough and sometimes necrotic base, is surrounded by a red inflammatory zone, and is accompanied by more or less inflammatory edema. In cases of long standing or of much inflammation, there may be considerable round-cell infiltration and induration around the ulcer and under it, but there is rarely, if ever, the marked parchmentlike or cartilage-like induration that develops under the primary lesion of syphilis.

Diagnosis.— The diagnosis of chancroid is based on the following points: (a) development within a few days or a week after suspicious coitus; (b) location and mode of development and appearance of the lesion; (c) two or more lesions, indicating autoinoculation (Fig. 375); (d) absence of parchmentlike or cartilage-like induration under the ulcer; (e) presence of painful bubo, tending to suppuration; (f) in a doubtful case, bacteriologic examination is made to establish the presence of the Ducrey bacillus.

Treatment.—For chancroidal ulcer, cleansing and soothing treatment have supplanted the severe cauterizing applications formerly employed, which stirred up too much reaction. Washing with hot water and hot applications are employed, and if the ulceration is extensive, hot sitz baths. Between the hot applications, the ulcer may be kept covered with a weak solution of iron and potassium tartrate, which seems to help very much in some cases.

X-ray treatment has been used with much benefit in various acute inflammations, and a trial of it is advisable in this severe type if not yielding to other measures.

When the ulcer begins to spread rapidly, more severe cauterizing treatment may be advisable. Jacobsen reports strikingly good results with formalin treatment, which he describes as follows:

.After the parts involved have been anesthetized and the lesion has been thoroughly cleansed of all secretion and débris, undiluted solution of formaldehyde (U.S.P. 37 per cent),

commercially known as formalin, should be applied to every portion of the lesion. The swabbing and application should continue for three to five minutes. Then the excess of formalin and secretion should be wiped off and a sterile unctuous dressing applied. For subsequent dressings we have used an ointment containing 1 or 2 per cent of camphor.

Formalin thus thoroughly applied acts as a specific. In the majority of instances, one application will suffice. For extensive ulcerations a second or third application may be necessary. Immediately after the first treatment, the pain and distress, previously experienced, are entirely relieved and the patient is comfortable. As one patient expressed it, "the ulcer quit eating." Formalin has a strong bactericidal action. When applied early, it prevents suppurative inguinal adenopathy, probably due to the fact that formalin is absorbed by the lymphatics. On the other hand, formalin does very little damage to the normal tissue. The lesion so treated soon becomes covered with a crust under which healing rapidly takes place.

For chancroidal adenitis, rest and sedatives are advisable, with cold or hot applications, whichever give most comfort. The electric baker is a convenient apparatus for applying dry heat. In this severe type of adenitis, a trial of x-ray treatment is advisable, along the lines of such treatment of acute inflammation generally.

As to special general treatment, a Ducrey vaccine is now available for diagnosis and for treatment. Also, the sulfonamides may be helpful.

Fig. 375.

Fig. 376.

Fig. 375.—Chancroidal ulcers of the vulva. (Bovée—*Practice of Gynecology.*)
Fig. 376.—Secondary syphilitic lesions. (Bovée—*Practice of Gynecology.*)
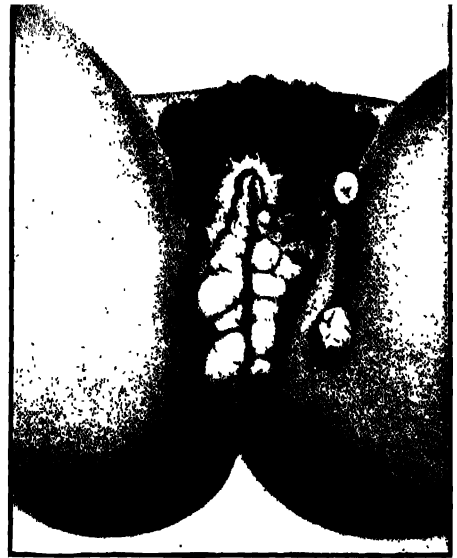
Syphilis
of Vulva and Vagina

Syphilis is a general infectious disease, characterized by an initial sore (the point of entrance of the infecting germ) and by general secondary manifestations after several weeks and by tertiary lesions, localized in various parts of the body, usually only after several years.

The infectious agent is the *Spirocheta pallida,* a very small microbe which is found in all lesions (primary, secondary, and only rarely in tertiary). The demonstration of this germ, by proper staining methods or by examination in the dark-field, makes possible a positive diagnosis of syphilis at once, even in the primary stage and long before the positive clinical evidences appear. The positive identification of this infectious germ requires considerable bacteriologic experience, hence the specimens should be sent to a pathologist.

Fig. 377.

Fig. 378.

Fig. 377.—Syphilitic infiltration and condylomata about the vulva. (Hirst—*Diseases of Women.*)

Fig. 378.—Syphilitic condylomata. (Ravogli—*J. A. M. A.*)
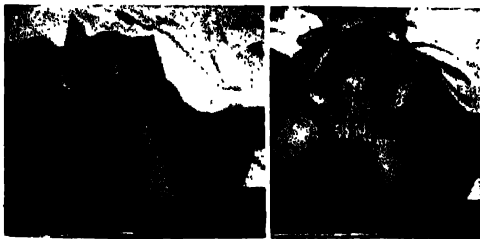
Fig. 379.

Fig. 380.

Fig. 379.—Syphilitic ulceration of vulva, with resulting stasis hypertrophy. Two views of the condition. (Gallagher—*Surg., Gynec. and Obst.*)

Fig. 380.—Syphilitic ulceration of vulva, with resulting stasis hypertrophy. Two views of the condition. (Gallagher—*Surg., Gynec. and Obst.*)

The directions for preparing specimens are as follows:

In case of a suspected PRIMARY LESION (chancre), wipe the surface of the ulcer with cotton or gauze thoroughly; avoid causing bleeding. From the "irritation serum" which results, make a **spread-preparation** on a slide or cover glass, just as in making a preparation of blood. Half a dozen specimens are made and dried and then packed for transmission.

In SECONDARY LESIONS (mucous patches, moist papules, dry papules), a spread-preparation of the "irritation serum," made as above directed, will usually suffice for a diagnosis. A negative finding, however, does not certainly exclude syphilis. Consequently, to make the diagnosis certain, a **tissue specimen** should be examined. This is easily secured by clipping off a small papule. Preserve all tissue specimens to be examined for the *Spirocheta pallida,* in 10 per cent formol solution. Specimens preserved in alcohol do not stain so well.

In TERTIARY LESIONS only **tissue specimens** can be used for bacteriologic diagnosis, though of course the Wassermann blood reaction is effective in all stages of the disease. For the details of the primary and secondary and tertiary manifestations of syphilis, see descriptions in general medical works. Fig. 376 shows vulvar "mucous patches" of the secondary stage, and Figs. 377 and 378 show syphilitic condylomas. Figs. 379 and 380 show syphilitic ulceration of the vulva, with stasis hypertrophy of the affected parts.

Fig. 381.   Fig. 382.

Fig. 381.—Syphilis of vulva, microscopic section. Low power. Notice epithelial proliferation and areas of round cell infiltration. (Gallagher—*Surg., Gynec. and Obst.*)

Fig. 382.—Syphilis of vulva. High power, showing giant cell.

When the diagnosis remains doubtful, because of absence of general confirmatory signs or because of the possibility of a mixed lesion, excision of tissue for microscopic examination may be advisable. The microscopic tissue alterations are shown in Figs. 381 to 383.

Treatment.—A patient should not be given constitutional treatment for syphilis until the diagnosis is positive. As a rule, a positive diagnosis before the appearance of the "secondaries" is not possible by the ordinary clinical evidences, not even by the Wassermann reaction, which at this time still may be negative. By bacteriologic examination, however, a positive diagnosis may be made at once, even in the very earliest stage of the primary lesion, when typical spirochetes are present.

When the diagnosis is thus made early, it is recommended by some authorities that the primary lesion be at once completely excised—not with the idea of

preventing general syphilis, but to modify it and lessen the effect of the succeeding stages. This excision treatment of the primary lesion is still experimental.

Otherwise the only treatment that the primary lesion requires is local cleansing and antiseptic measures, supplementary to constitutional treatment. The secondary and tertiary lesions require regular constitutional treatment for syphilis, the details of which can be found in works treating of that subject.

The local treatment for the secondary and tertiary lesions of the vulva and vagina is simply cleansing and antiseptic and astringent, i.e., the same as for simple ulcers.

Fig. 383.—Syphilis of vulva. Microscopic section, showing very marked epithelial prolongations into the underlying tissues. Gyn. Lab.

Tuberculosis of Vulva

Tuberculosis of the vulva is the term applied to those lesions of the external genitals produced by tubercle bacilli (Figs. 384, 385). Tuberculosis of this region and other forms of persistent vulvar ulceration were formerly described together under the terms "lupus vulvae," "lupus hypertrophicus," "lupus perforans," "ulcus rodens," "destructive ulcer of vulva," and "perforating ulcer of vulva." As the pathology of the various forms of ulceration was gradually worked out, it was found that in many of the cases of destructive ulceration, tubercle bacilli were present. The tuberculous lesions were then formed into a class by themselves and this class includes a large number of the cases of persistent ulceration formerly described under the titles above mentioned.

Tuberculosis of the vulva is due to local infection with the tubercle bacillus. The infection may take place through an abrasion, in which case the infecting germ may be brought to the abrasion by a tuberculous discharge from the uterus or vagina, or possibly by coitus with a husband having a tuberculous lesion of the genitourinary tract or by fingers or clothing infected with tuberculous discharge either from the patient or from some other person.

On the other hand, tissues may, in rare cases, be infected without any break in the epithelial covering. In such a case the tubercle bacilli come by way of the blood or lymph.

Diagnosis.—Tuberculosis of the vulva begins as a small nodule, usually situated near the meatus or the clitoris or at the posterior commissure. After a time the nodules break down and form small ulcers. The ulcers have hard margins and an irregular base and are very liable to have an area of irregular infiltration about them.

Fig. 384.   Fig. 385.

Fig. 384.—A tuberculous ulcer of the vulva. (Kelly—*Operative Gynecology*.)
Fig. 385.—Tuberculosis of vulva. (McGlinn—*Am. J. Obst. and Gynec.*)

Tuberculous ulcers are chronic and persistent and may extend deeper and deeper until fistulous openings are formed into the rectum or bladder or urethra, hence the name "perforating ulcer." Even when adjacent cavities are not opened, the ulcers, in conjunction with the contracting scar tissue, may form sinuses and discharging surfaces extending deeply in various directions, and sometimes causing perforations through the labia.

A positive diagnosis requires a microscopic examination. In a doubtful case the crucial test of the character of the ulceration consists in finding tubercle bacilli in the secretion or in demonstrating the characteristic pathologic changes in a specimen of tissue removed from the margin of the ulcer.

Treatment.—If there are no marked tuberculous lesions elsewhere, the chance of eliminating the local lesion by x-ray or radium treatment is very good. If the involved area is so situated that it can be completely and easily excised, it is well to thus eradicate it. If, however, the lesion is at all extensive, excision involves considerable uncertainty as to complete removal and occasions considerable subsequent deformity. As a rule, it is better to use x-ray, and if that is not successful, then radium. Beware of the sloughing effect of radium about the urethra. Actinic light therapy is used extensively in Norway, Sweden and Denmark for such ulcerations.

Tuberculosis of Vagina

Tuberculosis of the vagina (Fig. 386) is usually secondary to tuberculosis of the uterus and tubes, the vaginal surface being infected from the tuber-
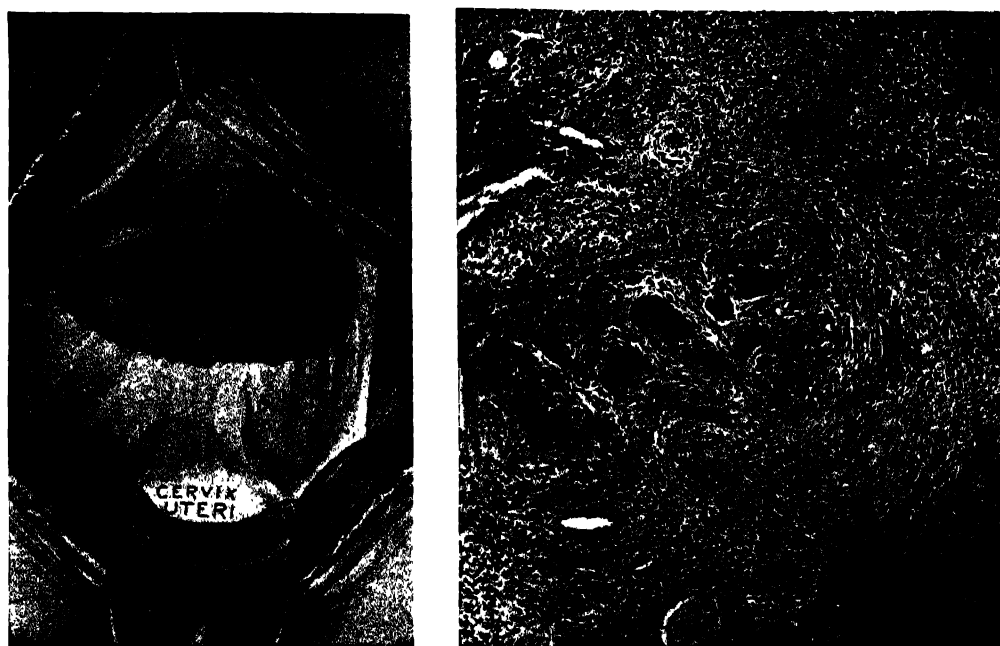
Fig. 386.—*A*, Tuberculosis of vagina. *B*, Microscopic section showing giant cells. (Cullen—*Surg., Gynec. and Obst.*)

culous discharge from above. Some cases occur, however, in which there is no tuberculous trouble higher in the genital tract. In such a case the vaginal tuberculosis may be due to sexual intercourse with a husband having a tuberculous lesion of the genital tract, or to the use of an infected douche nozzle or to the extension inward from tuberculosis of the vulva.

The most common site for vaginal tuberculosis is the posterior vaginal fornix, which region comes most in contact with the uterine discharges. It is supposed that the resistance of the vaginal epithelium must be lowered by an irritating discharge, or otherwise, before invasion by the tubercle bacillus can take place. The first manifestation of tuberculosis of the vaginal wall is the development of a number of miliary tubercles. These may be confined

to a small area, for example, to the posterior fornix, or may appear over a large part of the surface at once.

Each miliary tubercle is a small, raised, grayish or yellowish dot, the size of a millet seed or smaller. As the lesions develop they break down and form small ulcers, which may coalesce and form ulcers of various sizes. The tuberculous ulcer has a punched-out appearance, the edges being perpendicular, and the base is yellowish gray and may show many miliary tubercles. The miliary tubercles frequently occur in large numbers in the hyperemic zone about the ulcer.

Symptoms and Diagnosis.—The stage of ulceration is usually the time at which the patient consults the physician, complaining of discharge and discomfort. Examination reveals the suspicious ulcer or ulcers and further investigation will usually show tuberculous disease of the uterus or tubes.

The discharge from a tuberculous ulcer contains tubercle bacilli, but sometimes in such small numbers that they are not found when the discharge is stained and examined. In a doubtful case, some tissue from the margin of the suspected ulcer may be submitted to microscopic examination. In such a specimen, in addition to the tubercle bacilli, there are found the characteristic giant cells and necrotic areas. Another way of testing for tuberculosis in the laboratory is by injecting some of the secretion into the peritoneal cavity of a guinea pig, where in time it causes tuberculous peritonitis with characteristic lesions.

Treatment.—The treatment is the same as that described under Tuberculosis of Vulva.

Granuloma Inguinale

(Due to the Donovan Bacillus)

This tropical form of ulceration about the genitals (Figs. 387, 388) has been found to occur not infrequently in temperate zones. Following the early report of Symmers of two cases in Bellevue Hospital, New York, Randall, Small and Belk reported sixteen cases from the Philadelphia General Hospital. This latter is a very extensive and complete article, and the reader is referred to it for a most satisfactory consideration of the many features of the subject. The main points of the affection may be stated as follows, quoting from the article:

1. Granuloma inguinale, long considered a tropical disease, is endemic in the temperate zone of the United States.

2. Its diagnosis is dependent on (a) the characteristic local lesion, (b) the marked predominance in the negro race, and (c) the finding of the specific organism originally described by Donovan (Figs. 389, 390).

3. Wassermann tests have been negative with a few exceptions, where undoubtedly a double infection has been present, and in these, energetic antiluetic treatment has been devoid of effect upon the granuloma.

4. Treatment with tartar emetic intravenously acts as a specific, and rapid healing may be expected (Figs. 391, 392) with the prompt disappearance of the specific organism.

The usual history is that the lesion started as a small papule, noninflammatory, which after rupture and the exudation of a slightly purulent fluid, refused to heal, and exhibited progressive tendencies toward slow proliferation and spreading. The typical lesion (especially seen when involving the inguinal region, see Fig. 387) is a flesh-red, exuberant overgrowth of soft granulation tissue.

As indicated by the name, the most frequent location is in the groin, spreading upward as far as the anterior superior spine and downward through the fold of the groin, frequently involving the perineum, and in some cases following the fold of the nates and

spreading to the buttocks. In certain patients the history apparently points to granuloma infection superimposed upon a prior existent genital lesion.

We have based our diagnosis on the fairly characteristic clinical pictures, and also especially on the bacteriologic findings of the specific organism. This latter is done by making smears from the exuding surface in which will be found numerous large mononuclear plasma cells, the protoplasm of which, on proper staining, will be found studded with the characteristic encapsulated bacillus originally described by Donovan.

The smears are dried quickly in air and stained either by the Wright's or the Giemsa method. Wright's staining is the more rapid and has given satisfactory results. The proper differentiation of the stained smear in distilled water is the chief technical

Fig. 387.

Fig. 388.

Fig. 387.—Granuloma inguinale, showing the inguinal ulceration. (Symmers and Frost—J. A. M. A.)

Fig. 388.—Granuloma inguinale, showing extensive vulvar ulceration. (Randall, Small and Belk—Surg., Gynec. and Obst.)

Fig. 389.

Fig. 390.

Fig. 389.—Granuloma inguinale. The organisms stained in cells. (Randall, Small and Belk—Surg., Gynec. and Obst.)
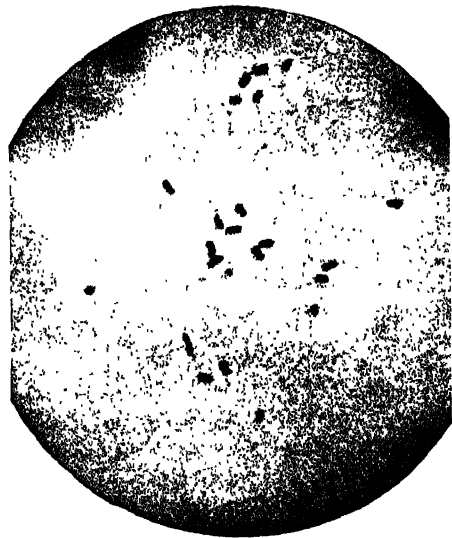
Fig. 390.—Granuloma inguinale. The isolated organisms stained. (Randall, Small and Belk—Surg., Gynec. and Obst.)

difficulty. Even with the most intense staining this differentiation should not be carried out for more than fifteen to twenty seconds. Overdifferentiation completely decolorizes the capsules of the organisms; while underdifferentiation fails to bring out detail and contrast between the body proper and the capsule. The best staining results show the organisms as small, rounded, pink bodies with a dark blue coccoid body in the center; or, more frequently as oval pink bodies with a blue bacillary or diplococcoid body occupying the longitudinal axis. The pink outer zone is a wide capsule. The dark blue central bodies represent metachromatic granules within the body proper. The true outline of the body proper can be studied only after the capsule has been entirely decolorized (Fig. 390).

Some cases of this disease affecting the cervix uteri have been reported, hence it is considered also along with other nonmalignant cervical lesions.

The therapeutic result from the use of antimony intravenously may likewise be taken as indicative of the accuracy of the diagnosis, for, after three or four administrations, the organism disappears entirely from the surface and cannot be found in the smears, and healing promptly follows. Any pudendal sore, resistant to the ordinary surgical antiseptics, unimproved by arsenical therapy, of long duration, and especially when devoid of pain, should be searched for the specific organism of granuloma inguinale and given the advantage of antimonial treatment.

Fig. 391.   Fig. 392.

Figs. 391 and 392   Granuloma inguinale, showing effect of treatment. Fig. 391 shows extensive ulceration which had persisted more or less for three years in spite of antisyphilitic and other treatment, including x-ray. Fig. 392 shows the ulceration entirely healed after two months of tartar emetic administration. (Randall, Small and Belk—*Surg., Gynec. and Obst.*)

Treatment.—Quoting from the article mentioned:

Following Vianna's work, we started giving antimony intravenously in the form of tartar emetic. The initial dose of 0.04 gram was used, and this quickly advanced to a maximum dosage of 0.10 gram. Our first treatments were given daily and most patients tolerated this until about ten doses had been given, but nearly all after that amount showed some symptoms of intolerance for the drug. We then began intermitting the daily dosage, governing the time by symptomatic data. This intolerance consisted of rheumatoid pains in the joints associated with stiffness, especially seen in the early morning on rising, most frequently located through the shoulder girdle, and as a rule wearing off during the course of the day. There have not been in any case symptoms of alarming character.

The drug has been prepared by dissolving 0.1 gram in 10 cubic centimeters of sterile normal saline solution and is best preserved in sealed sterile ampules. Intravenous administration is essential.

The typical encapsulated organisms cannot be demonstrated in smears from the lesion after the second or third dose of the tartar emetic. Healing commences within forty-eight hours after the first administration, and from then on almost daily progress can be appreciated.

Wolfe in a recent article advised the use of a new antimony compound called faudin.

If the ulceration does not yield promptly to the specific treatment, it would be well to supplement with x-ray therapy for the accompanying inflammation.

Lymphogranuloma Inguinale

(Due to a Filtrable Virus)

The use of the term "lymphogranuloma inguinale" for a disease occurring in the same location as granuloma inguinale and somewhat resembling it clinically, but entirely different etiologically, is confusing and unfortunate, but seems established for want of a better term. The two are entirely distinct diseases, granuloma inguinale being an ulceration of the skin due to the Donovan bodies (encapsulated bacilli), while lymphogranuloma inguinale is a disease of the lymph channels and nodes due to a filtrable virus.

Fig. 393.

Fig. 394.

Fig. 393.—Extensive fistulous estiomene of long duration, showing perianal fistulous opening. The Frei reaction was positive. (H. N. Cole—*J. A. M. A.*)

Fig. 394.—Chronic perianal nodules and scar formation accompanying a high grade stricture of the rectum. The Frei reaction was positive, the Wassermann reaction negative. (H. N. Cole—*J. A. M. A.*)

Lymphogranuloma inguinale in this country is seen most frequently in the negro. While in the male it usually appears as an inguinal lymphadenitis (hence the term "climatic bubo"), in the female it is more frequently seen as rectal ulceration. This location of the ulceration in the female is due to the perirectal distribution of the lymph nodes draining the perineum and posterior vaginal wall, which are the usual points of entrance of the virus.

There seems to be no special disturbance at the point of entrance. The lymphatic inflammation comes later, accompanied at times with fever and abdominal pain and occasionally multiple arthritis. Still there is ulceration of the rectum which may be accompanied by extension of ulceration out onto the

external genitals, as shown in Figs. 393 and 394. Marked involvement of the inguinal glands is rare in the female, but common in the male owing to the lymphatic distribution from the usual points of infection. Figs. 395 and 396 give the characteristics of the inguinal lymphadenitis. The ulceration in the rectum is likely to result later in stricture.

H. N. Cole called attention to the disease in this country and gave an interesting historical and clinical account of it. The Frei test and the differential diagnosis of the disease generally are gone into deeply. Some years ago W. R. Rainey and W. H. Cole reported several cases from the rectal clinic of the Washington University (St. Louis) School of Medicine, and from a more recent review of the subject by Rainey the following quotations are taken:

Pathogenesis.—The primary lesion is very insignificant and is usually overlooked. This appears in ten days to three weeks following exposure. The primary lesion may be a simple papule or multiple papules. The most frequent secondary manifestation is the inguinal bubo. This occurs more often in men, but may occur in women when the lesion is about the external genitalia. The chief characteristic of the bubo is its chronicity. It is generally unilateral and in time breaks down into multiple fistulae. The skin overlying

Fig. 395.

Fig. 396.

Fig. 395.—Characteristic bilateral lymphogranuloma inguinale. Three Frei reactions on the right forearm still positive after ten days. (H. N. Cole—*J. A. M. A.*)

Fig. 396.—Bilateral lymphogranuloma inguinale, showing a multiple fistulous opening. (H. N. Cole—*J. A. M. A.*)

the inguinal bubo becomes attached to the underlying inflamed glands and is of a bluish-red cast. A single gland may be involved or a conglomerate mass of glands involving the inguinal and femoral regions.

The second most frequent lesion is stricture of the rectum. This usually occurs in women and particularly in colored women, although there is no doubt that this lesion as well as all other manifestations of the disease are appearing more frequently in the white race. Where rectal stricture occurs, it is assumed that the primary lesion is within the vagina or about the cervical outlet. The third manifestation of the disease occurring in women is esthiomene or the deforming lesion about the external vagina resulting in massive fibrous infiltration which may tend to contract the vaginal outlet.

The fourth manifestation of the disease occurring in men may result in chronic or even permanent elephantiasis of the penis and scrotum. In rare instances partial destruction of the penis has been known. In atypical types the lesion has occurred upon the finger with secondary glandular manifestations at the elbow and in the axilla. The primary lesion has been known to come in the mouth with glandular involvement in the floor of the mouth and the glands of the neck. Recently, lesions occurring in portions of the large intestine have been recognized as manifestations of lymphogranuloma. Certain eye changes and involvements of the meninges have been observed in the acute stages and in

exacerbation of the disease. Other symptoms are: general temperature accompanied by abdominal soreness; and multiple arthritis with painfully swollen joints.

Diagnosis.—Since the clinical manifestations of the disease are now well recognized, the diagnosis is most easily arrived at, but the confirmation of the diagnosis depends upon the Frei Test. With an aspirating syringe the contents of an inguinal bubo are removed and diluted one to ten or one to four in normal saline solution. This is treated to one hour of 60° Centigrade on one day and followed by a second hour the next day. The antigen is now tested by culture for bacteria and to prove its efficiency is tested upon a known case of lymphogranuloma venereum. The Frei test is made by introducing about .01 c.c. of the antigen into the forearm. The maximum reaction is within 48 hours and results in an area of induration encircled by a ring of erythema. The readings are classed one, two, three or four.

Treatment.—The treatment was unsatisfactory until the advent of the sulfonamides. Antimony and potassium tartrate were used with indifferent results. The Frei antigen was employed for treatment. Some results were reported from x-ray treatment. With the appearance of sulfanilamide, excellent results were reported by Rainey and by Shopshear and by others. Sulfathiazole has given about the same results as sulfanilamide, and the treatment with the sulfonamides appears most promising.

Rarer Ulcerations

Though these conditions are infrequent, they may be encountered and hence are mentioned to call attention to them.

Actinomycosis.—Actinomycosis of this region occurs usually as an indurated area in the groin, which may ulcerate with the ulcerating surfaces presenting yellow granules. The disease is easily identified microscopically.

The treatment is by thymol, and Meyer reports on six cases he treated. The drug was given by mouth in the form of thymol crystals in capsules, 1.5 grams in one dose on alternate days for twenty to thirty days. The capsules are given in an empty stomach, to avoid retention and also to obtain as high a concentration in the circulation as possible. Locally a solution of 10 to 20 per cent thymol in olive oil is injected into the lesion. Of the six cases, four were cured, one still had draining sinuses and one who refused to continue treatment died of extension of the disease to the lungs.

Tularemic Buboes.—Pasternack reported two cases of this condition and mentioned that there are six cases in the literature. The disease is caused by the bite of wood ticks, dog ticks, and certain other species of ticks which are hosts of the *Bacterium tularense*. The symptoms are those of an undulant fever plus enlarged tender inguinal glands. Francis pointed out that certain ticks are important agents in the transmission of tularemia. Ticks bite under the clothing in the hairy regions, and the perineum and genitalia are favorite sites, result in inguinal lymphadenitis.

Foreign-Body Granuloma.—In the differential diagnosis of chronic ulcerations it must be kept in mind that powder grains of various kinds may become embedded in tissues and give rise to foreign-body granulomas which may be persistent and troublesome. Antopol and Robbins report instances of lycopodium powder causing puzzling granulomas of the peritoneum, from use on operating gloves, and of the rectum from use on suppositories. They show lycopodium

spores in sections of the granulation tissue. McCormick and Ramsey review the subject extensively in a recent article.

Ulcus Rodens Vulvae.—From the large group of affections formerly classified roughly under the terms "rodent ulcer," "lupus," "esthiomene," "perforating ulcer" and similar names, there have been cut out distinct classes, until now these cases are pretty well divided up as syphilis, tuberculosis (to which the term lupus is now restricted), granuloma inguinale and malignant disease, with special characteristics for each. There still remain, however, certain persistent destructive ulcers, but rarely seen, whose etiology is not definitely known. These are designated by the noncommittal term "ulcus rodens" (gnawing ulcer).

URETHRAL CONDITIONS

These are eversion of urethral mucosa, prolapse of urethral mucosa, urethral caruncle, Skene's gland infections, and periurethral abscess.

Fig. 397.   Fig. 398.   Fig. 399.

Fig. 397.—Relaxation of urinary meatus, with slight eversion of mucosa. A rather common condition in multiparas.

Fig. 398.—Prolapse of the urethral mucosa. (Montgomery—*Practical Gynecology*.)

Fig. 399.—Urethral caruncle. (Montgomery—*Practical Gynecology*, The Blakiston Company.)

Widening of Meatus

This condition of widening of the ureteral meatus, so that a considerable area of red urethral lining shows, is due usually to stretching from childbirth. It is not of much clinical importance, rarely giving rise to discomfort, though the exposed mucosa is of course liable to irritation from any irritating vaginal discharge. The appearance is shown in Fig. 397. It is to be distinguished from prolapse of the mucosa, caruncle, skenitis or other definite chronic irritation requiring elimination.

Prolapse of Urethral Mucosa

Prolapse of urethral mucosa is known also as "procidentia urethrae." It consists of a prolapse of urethral mucous membrane, accompanied by more or less proliferation of the submucous connective tissue.

The red projecting membrane surrounds the meatus (Fig. 398). It often bleeds easily and is somewhat sensitive to the touch, though not nearly so sen-

sitive as a caruncle. It usually gives rise to considerable irritation, with frequent painful urination and some discharge. It is distinguished from polypus and caruncle by the fact that it surrounds, or almost surrounds, the meatus.

Marked prolapse of the urethral mucosa is not a common affection, though slight gaping of the urethra, through which the mucous membrane may be seen (eversion of urethral mucosa, Fig. 397), is very common in women who have had urethritis or have passed through several labors.

If symptoms are absent or slight, no treatment is necessary. If the prolapse is marked enough to be troublesome, the part may be cocainized, or the patient anesthetized, and the redundant portion of mucous membrane excised and the wound closed by sutures.

Urethral Caruncle

Urethral caruncle is a small papillary growth occurring about the meatus, most frequently near the lower portion. It is usually very sensitive and often gives rise to excruciating pain on urination. It is known also as "irritable caruncle" and "urethral angioma." The cause of urethral caruncle is not known. Probably chronic inflammation of Skene's glands has some influence in its causation, as it usually occurs in the neighborhood of the gland openings. Inflammation of the urethra, particularly gonorrheal inflammation, is supposed to be a causative factor.
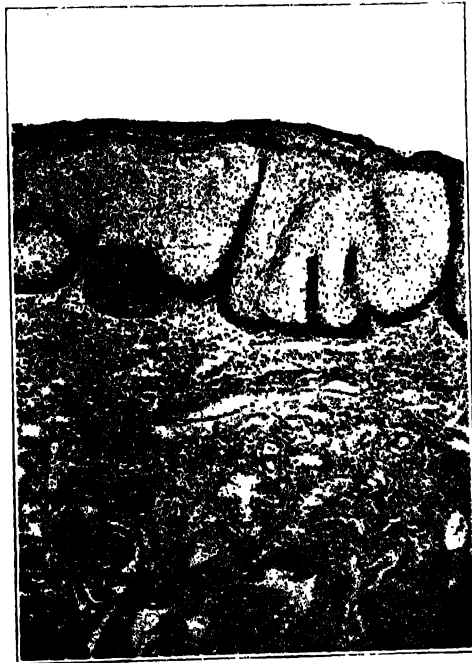
Fig. 400.—Urethral caruncle, showing thickened epithelium, dilated vessels, and inflammatory areas. Gyn. Lab.

The growth is seen as a deep red mass at the meatus (Fig. 399) or just within the canal. It is sensitive when touched and may bleed easily on manipulation. It may have a distinct pedicle or a broad base. Usually there is but one growth, but sometimes there are two or more. The microscopic appearance is shown in Fig. 400,

The principal symptom is pain on urination. It may be slight or it may be very severe.

Polypi of the urethral mucous membrane and prolapsed mucous membrane differ from caruncle in being less vascular and less sensitive. Also, polypi are attached higher, while in prolapse of the mucous membrane the base of the mass includes the larger part, if not all, of the circumference of the meatus (Fig. 398).

The treatment for caruncle is removal, preferably by electric current.

Skene's Gland Infection

The anatomy of these small urethral glands, described long ago by Skene, is shown in Figs. 118 to 121. It will be readily appreciated that infection in these may be harbored there indefinitely unless exposed and eradicated. Such infection is usually due to the gonococcus, but not always. The diagnosis is made by finding swelling or tenderness of the glands, and pressing out discharge, as explained in Figs. 182 to 184. The treatment of inflammation of Skene's glands is given under gonorrhea, with which urethritis also is considered.

Suburethral Abscess

This term is applied to an abscess due to infection from the urethra and located in the tissues about it, such abscess being situated under the urethra (either primarily or gravitating there) between it and the vaginal wall, as shown in Figs. 401 and 402. The pocket of pus may communicate with the urethra or may be shut off from it, and be pointing toward the vagina.
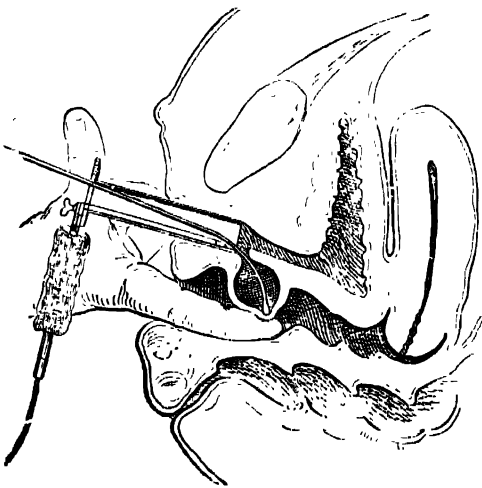
Fig. 401.

Fig. 402.

Fig. 401.—Testing for suburethral abscess. (Ashton—*Practice of Gynecology*, W. B. Saunders Company.)

Fig. 402.—Suburethral abscess. View from in front. (Kelly—*Operative Gynecology*, D. Appleton-Century Company.)

The treatment for this condition is to drain the cavity at the most dependent part, that is, where it comes closest to the vaginal wall. At this point a large opening should be made and the incision should be kept open by gauze packing or a drainage tube until the cavity heals from the bottom.

VULVOVAGINAL GLAND DISEASES

The nonmalignant conditions include inflammation, abscess, sinus, cyst, and tuberculosis. Cancer of the gland is considered under malignant disease of the vulva.

Inflammation of Vulvovaginal Gland

Inflammation of the duct of the vulvovaginal gland and of the gland proper has been considered under Gonorrhea. Inflammation in this gland of Bartholin is sometimes referred to as "Bartholinitis."

Fig. 403.   Fig. 404.

Fig. 403.—Abscess of vulvovaginal gland, left side. (Kelly—*Operative Gynecology.*)
Fig. 404.—Another case of abscess of vulvovaginal gland, right side. (Hirst—*Diseases of Women.*)

Abscess of Vulvovaginal Gland

The cause is infection with the gonococcus or ordinary pus germs, or trichomonads. The first is by far the more frequent, and the gonorrheal inflammation often persists in the gland long after the vaginal inflammation has disappeared.

The infection enters at the mouth of the duct and progresses along the duct to the gland proper. The secretion of the gland is increased, the duct becomes obstructed and a collection of pus forms, distending the gland and pointing in the direction of least resistance. Sometimes the duct alone is involved, the gland proper escaping. This is indicated by the swelling being small and confined to the region of the duct.

Pathology.—Microscopically one sees a marked round cell invasion about the gland. In the acute cases, pus is seen in the lumen and duct of the gland. In chronic cases the alveoli are dilated, and the lining mucous membrane shows flattened cylindrical epithelium.

Symptoms and Diagnosis.—The symptoms are a painful swelling at the side of the vaginal opening with some fever. Examination reveals a swelling the size of a small egg situated in the tissues at one side of the vaginal orifice and projecting beyond the median line (Figs. 403, 404). The swelling is tender on pressure and there is fluctuation. The following conditions must be differentiated:

CYST OF VULVOVAGINAL GLAND is a chronic affair, the patient usually giving a history of the swelling having been there for a long time, and the inflammatory signs (heat and pain and redness) are absent.
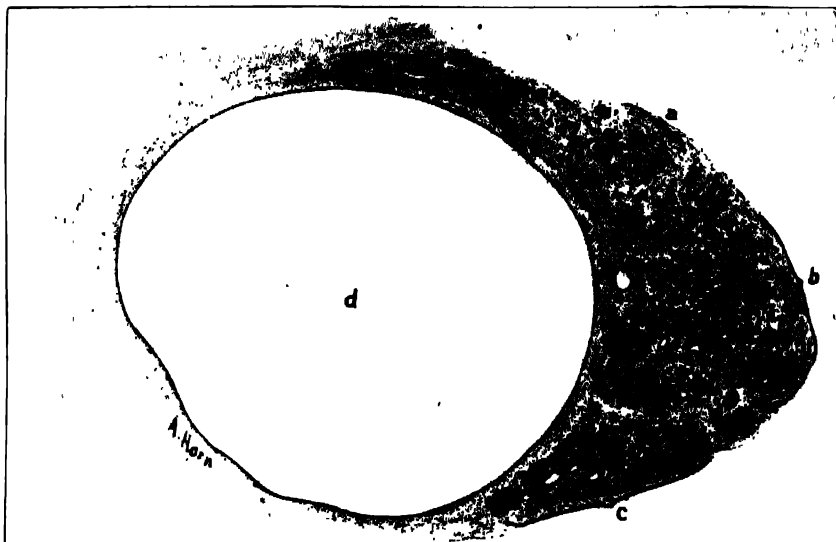
Fig. 405.—Cyst of duct of vulvovaginal gland. Notice how the gland substance has been pushed aside by the cystic duct. (Cullen—*J. A. M. A.*)
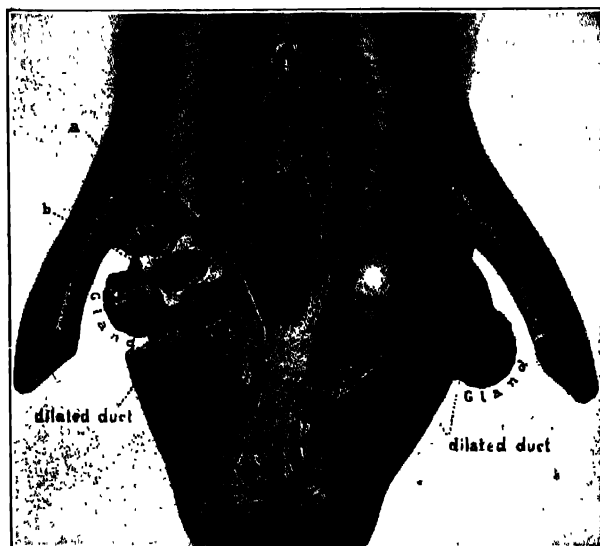
Fig. 406.

Fig. 407.

Fig. 406.—Deep relations of vulvovaginal glands when ducts become cystic. (Cullen, after Hugier—*J. A. M. A.*)

Fig. 407.—Cyst of right vulvovaginal gland and duct. (Montgomery—*Practical Gynecology.*)

PUDENDAL HERNIA must always be taken into consideration in determining the character of a swelling of the vulva. Hernia presents one or more of the hernial signs, such as impulse on coughing, reducibility, intestinal obstruction, resonance on percussion. The first evidence of hernia is usually noticed at once after some straining effort or injury, much more promptly than either abscess or cyst would appear.

TUMOR OF LABIA differs from abscess in the absence of inflammation, in growing slowly and in presenting the signs that distinguish the various kinds of vulvar tumors.

Treatment.—Open the abscess freely by an incision where the pus is nearest the surface, and provide for subsequent drainage that the edges of the incision may be kept separated until the cavity granulates from the bottom.
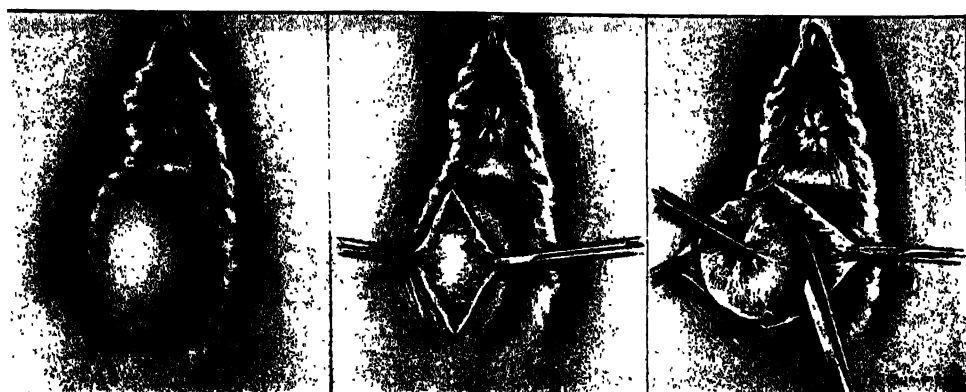
Fig. 408.   Fig. 409.   Fig. 410.

Figs. 408-410.—Enucleation of the cyst of a vulvovaginal gland.

Fig. 408.—Showing the relations of the cyst.
Fig. 409.—The incision through the overlying tissues
Fig. 410.—The cyst almost enucleated.

Fig. 411.   Fig. 412.   Fig. 413.

Fig. 411.—Ligating the vascular pedicle.
Fig. 412.—Closing the wound with a continuous suture of forty-day catgut.
Fig. 413.—Another method of closing—with silkworm-gut suture. (Crossen—*Operative Gynecology*.)

Sinus of Vulvovaginal Gland

In many cases of abscess of the gland, after the pus is discharged the cavity closes entirely and there is permanent cure. In other cases a sinus persists, giving rise to a constant slight discharge. The outer end of the sinus

may close and a reaccumulation of pus take place, forming another abscess. This may be repeated several times in the course of a few years. Again, in inflammation of the vulvovaginal gland, the duct may remain open, giving exit to the pus as it forms and constituting a sinus or discharging tract.

The diagnosis of sinus of the vulvovaginal gland is made by the history of inflammation of the gland associated with a sinus in that locality. By palpating the gland, as explained in Chapter II, it can often be felt as a small hard lump, indicating infiltration and enlargement. Pressure on this lump will sometimes cause pus to flow from the sinus.

As to treatment of a persisting sinus, the way to effect a permanent cure is to extirpate the sinus tract and the infiltrated gland.

Cyst of Vulvovaginal Gland

A cyst of this gland is due to obstruction of the duct, causing it and the gland to become dilated with retained secretion, as shown in Figs. 405 to 407 In some cases of inflammation, gonorrheal and otherwise, cyst of the gland results instead of abscess.
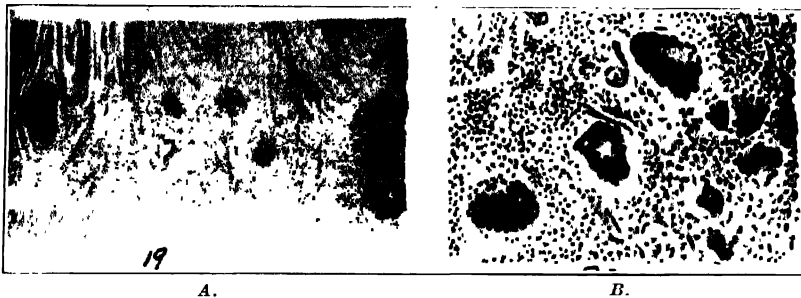
Fig. 414.– Tuberculosis of vulvovaginal gland. A, Microscopic, low power. B, High power, showing giant cells. (Davis—*Tr. Am. Assn. Obst. and Gynec.*)

As to diagnosis, the form and location of the swelling are like that of an abscess of the gland but none of the acute inflammatory symptoms are present. The only affection that is liable to be confounded with this cyst is pudendal hernia. The distinguishing characteristics of hernia are marked increase of the trouble on straining, obstructive bowel disturbance, impulse in the mass on coughing, tympanitic percussion note over the mass (if containing bowel) and the possibility of partial or complete reduction into the peritoneal cavity.

Treatment.—If the cyst is large enough to give trouble mechanically or is tender at times, extirpation is advisable. Though this may appear to be a small operation, it is really rather extensive, for the enlarged gland extends deeply, the parts are vascular, and much suturing is needed for hemostasis and approximation, and to draw in tissue for diminishing the hollow left by removal of the mass. The steps are indicated in Figs. 408 to 413.

Tuberculosis of Vulvovaginal Gland

Tuberculosis of the vulvovaginal gland occurs occasionally and must be kept in mind in any persistent ulceration in this region. Microscopic examination of curetted granulation tissue or an excised specimen will settle the matter (Fig. 414). The treatment is the same as for tuberculosis elsewhere in this region, for which see tuberculosis of vulva.

NONMALIGNANT GROWTHS AND SWELLINGS OF VULVA

These include condylomas, stasis hypertrophy, tumors, hernia, hydrocele, varicose veins, and hematoma.

Condylomas of the Vulva

Condylomas are small nonmalignant growths occurring about the vulva. There are three varieties: the common wart (verruca vulgaris), the pointed condyloma (condyloma acuminatum), and the flat condyloma (condyloma latum). The common wart occurs frequently about the vulva. It is usually situated on the labia majora or mons veneris. The particular cause for it is not known. It is dry and sometimes much pigmented, but rarely causes any disturbance. Moles also may occur here as on other skin surfaces.

Fig. 415.

Fig. 416.

Fig. 415.—Scattered condylomata of the vulva. (Hirst—*Diseases of Women.*)
Fig. 416.—Small masses of condylomata. (Gilliam—*Practical Gynecology*, F. A. Davis Company.)

The POINTED CONDYLOMA or moist wart occurs on those parts of the vulva which are frequently moist, namely, the vestibule, the vaginal entrance, the labia minora, the perineum, and about the anus. In some cases they occur on the labia majora and even on the thighs. (Figs. 415, 416.)

They are usually associated with venereal disease but not necessarily so. They are small, pointed, papillary masses with a thick covering of epithelium (Figs. 417 to 419). They occur singly or in groups or in large numbers. They may vary in size from that of a pinhead to that of a large cauliflower mass, covering half or more of the vulva.

They are due to some irritating discharge, usually gonorrheal. Sometimes they are due to a simple discharge as, for example, the increased vaginal discharge of pregnancy. When present during pregnancy they grow very rapidly.

Whenever they are found, a careful search should be made for evidences of previous gonorrhea or other cause of persistent vaginal discharge.

The FLAT CONDYLOMAS (Figs. 376, 377) constitute the characteristic vulvar lesions of secondary syphilis. If the overlying epithelial layers are thrown off, the flat condyloma becomes a superficial ulcer, as mentioned under Syphilis.
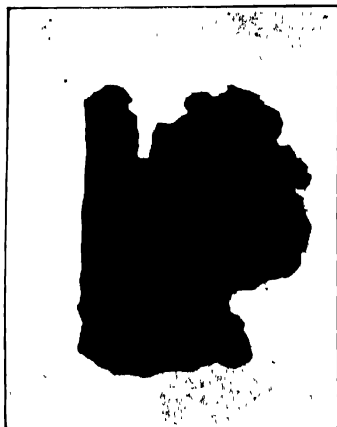
Fig. 417.

Fig. 418.

Fig. 417.—Pointed condyloma of vulva. Longitudinal section, low power. Gyn. Lab.

Fig. 418.—Pointed condyloma of vulva. Cross-section, showing distribution of the epithelium   Gyn. Lab.

Fig. 419.—Pointed condyloma of vulva. Longitudinal section, showing the marked thickening of the surface epithelium, and the distribution of the epithelium in the secondary projections. Gyn. Lab.

Treatment.—The common wart in this situation is likely to show frequent irritation and hence is best removed, especially if pigmented.

The pointed condylomas are treated by stopping any irritating discharge, with douches and local treatments, and keeping the condylomas clean and dry.

The latter may be accomplished usually by washing several times daily with a mild antiseptic solution, drying, and then dusting freely with some drying powder, such as talcum powder, stearate of zinc, calomel, or equal parts of calomel and salicylic acid.

If persistent and troublesome in spite of palliative measures, excision may be advisable.

The flat condylomas require the regular constitutional treatment for syphilis. Locally cleanliness should be secured by frequent washing with some mild antiseptic, and if there is much vaginal discharge, douches should be taken. After the washing, the parts are to be carefully dried and then dusted freely with some drying powder, such as calomel.
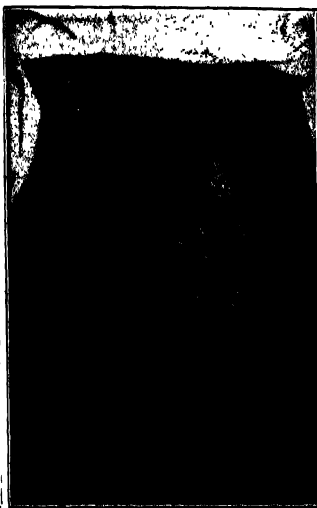
Fig. 420.   Fig. 421.   Fig. 422.

Fig. 420.—Stasis hypertrophy of the vulva. (Hirst—*Diseases of Women*, W. B. Saunders Company.)

Fig. 421.—Stasis hypertrophy of the vulva. (Hirst—*Diseases of Women*.)

Fig. 422.—Stasis hypertrophy of the vulva. The masses have been raised, showing remnants of the old ulceration and scar tissue about the pubic arch, which is usually responsible for this condition. (Kiliani—*Surgical Diagnosis*, William Wood and Company.)

Stasis Hypertrophy of Vulva

Stasis hypertrophy of the external genitals is a chronic enlargement of them, due principally to interference with the lymph circulation (Figs. 420 to 422). "Elephantiasis" is the term under which most authors describe this condition, but the import given to this word varies so much that its use leads to confusion. It has been applied on the one hand indiscriminately to nearly all chronic enlargements of the labia and, on the other hand, as a special term for the designation of the swelling due to the local invasion of the lymph channels by a parasite *(Filaria sanguinis-hominis)*. To prevent this confusion it is best to adopt another term, one about which there can be no misunderstanding and which indicates the most important factor in the evolution of the clinical picture. The essential lesion is a stasis hypertrophy, whatever the cause of the stasis may be.

Etiology.—There are three causative factors, as follows:

1. Chronic ulceration of the vulva. This has long been recognized as the etiologic factor in most cases. In Fig. 422 the masses are raised to show the ulceration beneath. Syphilis is present in a high percentage of the cases, but any form of chronic ulceration may lead to it.

2. Obstructive changes in the inguinal lymphatic glands. The closing of the lymph channels through the glands may be brought about by extirpation of the glands or by their damage by suppuration.

3. Local invasion of the vulvar lymphatics by the *Filaria sanguinis-hominis*. This is rare or unknown in this country, but it occurs as an endemic affection in some countries (India, Barbadoes, and the Antilles). Mosquitoes are thought to deposit the embryo beneath the epidermis. There the parasite multiplies to such an extent as to choke the lymph channels, the obstruction being due to both the parasites proper and the ova.

Diagnosis.—Examination reveals the enlargement and usually also the ulceration and scar tissue (Fig. 422). In the absence of infection, there are no acute inflammatory symptoms and usually but little congestion. The patients complain of some discharge and itching about the genitals and not infrequently symptoms of irritation on the part of the bladder and rectum. What usually brings the patient to the physician is the discharge and enlargement, with resulting discomfort and inconvenience in walking and difficulty in coitus. It must be differentiated from new growths and from hernia and from hypertrophies of special parts, as of the clitoris in masculinization or of the labia.

Treatment.—Stasis hypertrophy in temperate zones is practically always due to some type of chronic ulceration. Consequently, treatment calls for determination of the type of ulceration present and the adaptation of treatment accordingly. Occasionally excision of a troublesome mass is required along with the other measures.

Nonmalignant Tumors of Vulva

Fibrous tumors (fibromas) may occur in the connective tissue of the vulva. They are rare. When present they usually involve one of the labia majora (Fig. 423).

In some tumors there are also bundles of muscular tissue, evidently derived from the muscle fibers of the round ligament or of the skin. Such tumors are, of course, fibromyomas. Some tumors have a preponderance of fat (lipomas), the connective tissue simply forming trabeculae between the fat lobules. Still other tumors contain myxomatous tissue, giving the myxofibromas and the myxolipomas. A very rare form of tumor in this region is the chondroma. A few cases of chondroma of the clitoris have been reported, in at least one of which considerable ossification had taken place.

These nonmalignant tumors of the vulva may vary in size from that of an acorn to that of a child's head. They present, in this locality, the same symptoms and signs that characterize them elsewhere. The patient complains principally of the weight of the growth and of its being in the way. When large, they become pedunculated. On account of the friction the surface may

Fig. 423.

Fig. 424.

Fig. 423.—A large fibroma of the labium. (Montgomery—*Practical Gynecology.*)
Fig. 424.—Another large labial cyst. (Hirst—*Diseases of Women.*)

Fig. 425.

Fig. 426.

Fig. 425.—Small cysts of the left labium minus. (Kelly—*Operative Gynecology.*)
Fig. 426.—A cyst of the clitoris. (Kelly—*Operative Gynecology.*)

become abraded and infected and ulcerated, adding greatly to the patient's distress. The treatment for these growths is excision.

Occasionally sebaceous cysts occur on the labia majora or the mons veneris. They present the same characteristics and require the same treatment as sebaceous cysts elsewhere. Other cysts occur from remnants of fetal structures. Fig. 424 shows large labial cysts. Cysts of the vulvovaginal gland have already been considered.

Several cysts of the labia minora have been reported (Fig. 425). It is generally supposed that they arise from embryologically misplaced glandular rests. If large enough to be troublesome they are to be excised. Fig. 426 shows a cyst of the clitoris.

Pudendal Hernia

A pudendal hernia is a protrusion of the intestine or omentum or other intra-abdominal structure into the external genitals. It may take place by way of the inguinal canal in which case the hernia is designated as "inguino-labial" or "superior labial."

Fig. 427.
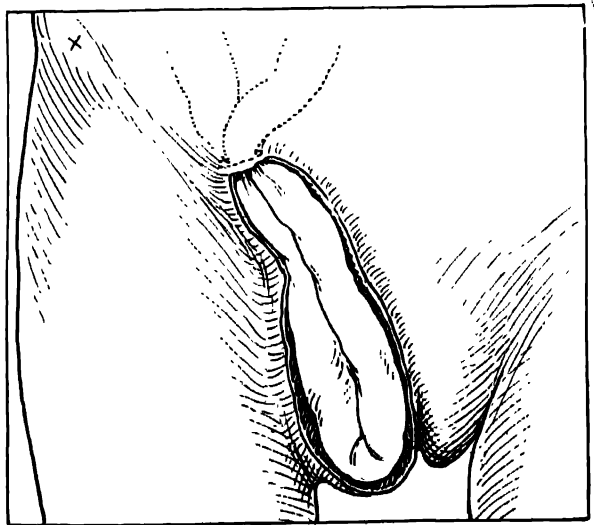
Fig. 428.

Fig. 427.—Pudendal hernia. Inguinal hernia becoming labial. (Dudley—*Practice of Gynecology*, Lea and Febiger.)

Fig. 428.—Inguinolabial hernia, diagrammatic.

The protrusion may take place by way of the vagina, in which case the hernia is designated as "vaginal," "vaginolabial" or "inferior labial."

Inguinolabial Hernia.—The round ligament ends in the tissues at the top of the labium majus. In the fetus, the ligament is accompanied along the inguinal canal by a prolongation of the peritoneum, forming a small cavity. This is usually obliterated in the full-term fetus. In some cases, however, it is not obliterated but remains open, forming a small pocket or "canal of Nuck," and along this canal an inguinal hernia may take place. The hernia may advance no further than the inguinal ring or, on the other hand, it may protrude more and more, involving the upper part of the labium majus and

later the whole labium (Figs. 427, 428). It corresponds to scrotal hernia in the male and presents practically the same pathology and symptoms. In some cases other structures than the intestine or omentum have been found in such a hernial sac, for example, the ovary, fallopian tube, uterus, and even the pregnant uterus.

Vaginolabial Hernia.—In rare cases a hernial protrusion may take place through the pelvic outlet by way of the vagina (Figs. 429 to 433). In such a case the hernia may descend in front of the broad ligament through the obturator foramen or between the uterus and the bladder, or behind the broad ligament, between the uterus and the rectum.
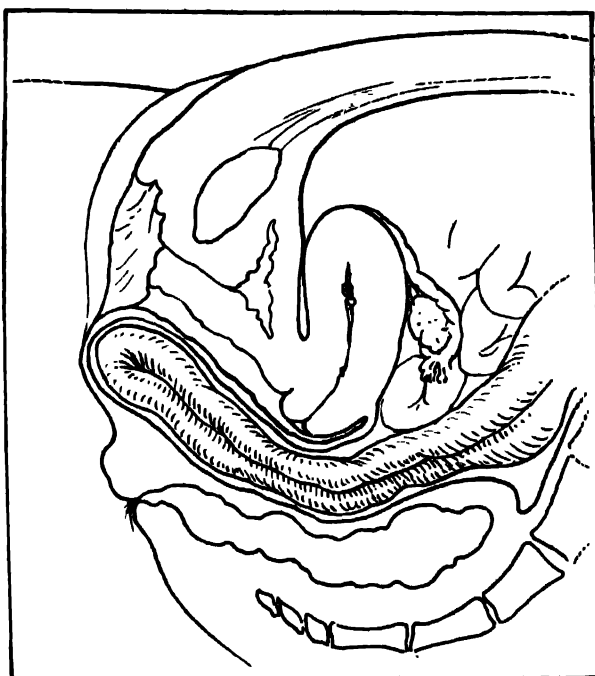
Fig. 429.   Fig. 430.

Fig. 429.—Vaginolabial hernia. (H. Macnoughton-Jones, after Winkel—*Diseases of Women.*)

Fig. 430.—Vaginolabial hernia, posterior type (cul-de-sac hernia), diagrammatic.

The latter type develops by pushing down the posterior peritoneal cul-de-sac between the vagina and the rectum. This "cul-de-sac hernia" (Figs. 430 to 433) is the most common form of vaginal hernia. It is prone to develop with prolapse of the uterus, and may be mistaken for simple rectocele. Unless the associated cul-de-sac hernia is taken care of along with the prolapse operation, it will persist and give trouble later.

Diagnosis.—Hernia differs from other swellings in this region, for example, hematoma, cyst, fibroma, stasis hypertrophy, cellulitis, in the following particulars:

IMPULSE ON COUGHING, however, may be absent if strangulation has taken place.

RESONANCE ON PERCUSSION is present only if the mass contains intestine. It is not found with omentum or ovary or tube.

MAY BE REDUCED INTO ABDOMINAL CAVITY.—This, of course, is possible only in reducible hernia. If the supposed hernia cannot be reduced with the patient in the dorsal position, she may be placed in the knee-chest posture and the reduction again attempted. This is especially effective in the vaginal form of hernia.

INTESTINAL OBSTRUCTION.—Usually there is not enough obstruction to produce serious symptoms or interfere with the passage of the intestinal contents, but when evidence of such obstruction does occur, it is a very important diagnostic symptom.

HISTORY.—Hernia usually appears in conjunction with some straining effort. Hematoma of the vulva is usually due to some external injury. Cellulitis follows a wound or ulcer. Stasis hypertrophy is preceded by chronic ulceration and scar-tissue formation. The other swellings of this locality (cyst, tumor develop gradually and without apparent cause.
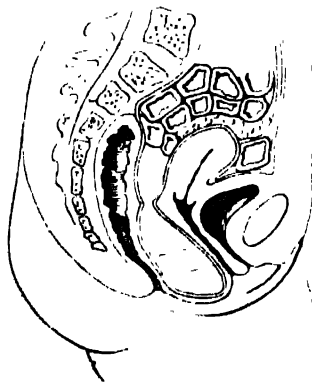
Fig. 431.   Fig. 432.   Fig. 433

Figs. 431-433.—Case of vaginolabial hernia, posterior type (cul-de-sac hernia). Fig. 431. Appearance of genitals. Notice the distention of the posterior vaginal wall and the perineum. Fig. 432. Sectional view, diagrammatic, indicating the location of the hernial sac and the point of constriction. Fig. 433. Appearance internally with the abdomen opened. Notice the hernial opening at the bottom of the retrouterine peritoneal cul-de-sac. (Sweetzer—*Ann. Surg.*)

Treatment.—The treatment for hernia in this situation is the same as for hernia elsewhere, namely, reduction and retention of the replaced viscera within the abdominal cavity, if that can be satisfactorily accomplished. An INGUINO-LABIAL hernia can frequently be retained with the ordinary hernia truss. If the reduction cannot be accomplished or if satisfactory retention cannot be secured, then operation for the radical cure of the hernia is indicated.

In the form of pudendal hernia in which the protrusion takes place by way of the pelvic outlet and vagina (VAGINOLABIAL), there is seldom enough obstruction at the hernial opening to produce intestinal symptoms.

Pudendal Hydrocele

In some patients, a canal persists along the round ligament, the internal end of the canal being closed. If a collection of fluid takes place in the sac thus formed, the result is a pudendal hydrocele, corresponding to hydrocele of the cord in the male. It is called also "labial hydrocele" and occupies the same location as an inguinal hernia.

It differs from hernia in that it is dull on percussion, cannot be reduced, gives little or no impulse on coughing, is not associated with evidences of intestinal obstruction, and has developed gradually without apparent cause. Great care is necessary in diagnosticating this rare affection, for it would be serious to mistake hernia for hydrocele and treat it by injection. It must be differentiated also from cystic adenomyoma of the round ligament. Several such cases have been reported. In hydrocele, the cyst wall would be thinner than in the cystic adenomyoma, though in some of the cases the adenomyoma can only be distinguished microscopically. Pudendal hydrocele must be differentiated also from hernia of the ovary with cystic degeneration.

Treatment.— If the collection of fluid is small and causes no inconvenience, leave it alone. If the swelling causes trouble, the sac may be opened and extirpated, and the wound closed by sutures. This is more certain of cure and much safer than injection treatment.

Varicose Veins of Vulva

The veins about the external genitals may become markedly varicose, the irregular dilatation being due to some obstruction to the pelvic circulation, such as pregnancy or a pelvic tumor. The dilatation of the veins only rarely gives rise to troublesome symptoms. Sometimes the patient complains of itching or of tension in the parts. Sometimes she becomes alarmed on account of the enlargement and consults the physician simply to know the cause. Occasionally, however, there may be marked enlargement (Fig. 434), with aching in the parts and much irritation of the skin. The danger in these cases is that a severe hemorrhage may take place, or a large hematoma form from slight injury or from spontaneous rupture of a varicose vein.

Treatment.— Usually no treatment is required beyond directing the patient to keep the bowels well open and to avoid lifting or straining as much as possible. Anything that increases the intrapelvic pressure or interferes with the pelvic circulation tends to increase the venous dilatation. In advanced pregnancy, an abdominal supporter takes some of the weight of the uterus from the anterior part of the pelvis and in that way may improve the circulation there. If the dilatation is sufficient to give the patient trouble, some relief may be afforded by a pad and T-bandage, so applied as to support the veins and prevent further dilatation. The patient should take the recumbent posture several times daily, and in some cases it may be advisable to keep her in bed continuously in the later weeks of pregnancy.

If there should be subcutaneous rupture of a vein, employ the treatment given under Hematoma.

If there should be external rupture, employ the treatment given below for open hemorrhage following injury.

When in the nonpregnant patient the veins are so much enlarged that they are troublesome, they may be excised. They are exposed by an incision through the skin covering them, the affected veins are isolated and ligated at each end and excised, the stumps are brought together, and the incision closed by sutures.

Hematoma of Vulva

A hematoma is a collection of blood in the tissues. The genitals are very vascular and also present much loose subcutaneous tissue into which hemorrhage may take place with but little resistance until a large mass is formed (Fig. 435).
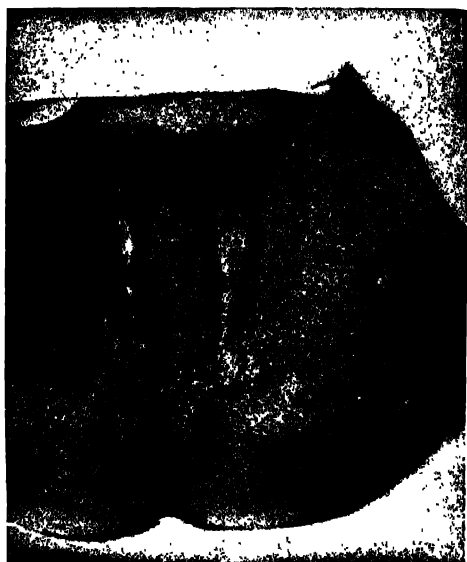
Fig. 434.   Fig. 435.

Fig. 434.—Varicose veins of the vulva. (Hirst *Diseases of Women.*)
Fig. 435.—Hematoma of the vulva. (Hirst—*Diseases of Women.*)

After some slight injury, a swelling is noticed, which increases rapidly in size and is accompanied by considerable pain, especially when the patient is standing. If large, the swelling distorts the parts very much, in some cases so much that the individual structures are identified with difficulty. The swelling presents induration and, if a large collection of blood has formed, there may be fluctuation.

Treatment.—Put the patient to bed and elevate the hips by placing a pillow under them, at the same time arranging a pillow under the knees so that the patient will be comfortable, and apply an ice bag over the swelling. The patient should be kept perfectly quiet in this position until the hemorrhage ceases—several hours if necessary. If there is much pain, sedatives should be given to keep the patient quiet. The cessation of the hemorrhage is indicated by the swelling ceasing to increase in size and by diminution in the pain.

If the hematoma is very large and increasing in size, it may be advisable to incise the swelling, under antiseptic precautions, turn out the clots, ligate the bleeding vessel or vessels, cleanse the cavity, and obliterate it with sutures.

Injuries of External Genitals

The genitals are in such a well-protected situation that injuries are rare. Such injuries as do occur, apart from labor, are due usually to a fall astride some object or to kicks and blows intentionally inflicted, or to injuries from coitus.

Injuries in this locality should be treated on the same general principles that govern the treatment of injuries in other localities; viz., stop hemorrhage, secure asepsis as far as possible, approximate divided tissues sufficiently to restore function, and afterward protect the wound with a suitable dressing.

There are two special characteristics of injuries in this locality that must be kept in mind:

1. **Free Hemorrhage.**—The parts are very rich in blood vessels, particularly veins, and slight injury may cause severe bleeding, either as external hemorrhage from an open wound or as subcutaneous hemorrhage from a bruise, giving rise to a hematoma.

An instance of troublesome hemorrhage from a slight injury is the persistent bleeding that occasionally follows the small tear of the hymen in the first coitus. On account of modesty and embarrassment, the newly married couple hesitate to call in assistance, and sometimes the bleeding persists for hours—until they do finally call a physician, who may find the bedding soaked with blood and the bride almost exsanguinated.

OPEN HEMORRHAGE from injury to genitals should be stopped by packing or by sutures or by forceps or by ligature of separate vessels or by ligature of the bleeding tissue *en masse*, as indicated by the nature of the wound. After treatment of the wound, the patient should be kept in bed with hips elevated until all tendency to hemorrhage is past. In attempting to stop hemorrhage, either from a wound or during an operation, if the bleeding vessels cannot be made out and the bleeding is free, the most satisfactory plan is to pass one or more sutures through the bleeding area and tie them.

In case of injury about the venous masses called the bulbs of the vestibule, the hemorrhage, whether open or subcutaneous, may often be controlled by packing the vagina firmly and then putting a firm compress over the vulva, such as a folded towel held in place by a strong T-bandage, making firm pressure.

In SUBCUTANEOUS HEMORRHAGE (hematoma) the patient should receive the treatment described elsewhere for that affection.

2. **Marked Swelling.**—In this locality the subcutaneous tissues are loose and decided swelling is liable to follow an injury, either immediately from subcutaneous hemorrhage or serous effusion or later from inflammatory exudate.

To prevent the swelling, or diminish it if present, put the patient to bed, elevate the hips and apply an ice bag over the parts. If the swelling is from inflammation, hot applications may give more relief than the cold.

For further treatment of vulvar swelling see Hematoma and also Cellulitis of Vulva.

NONMALIGNANT GROWTHS AND SWELLINGS IN VAGINA

Colpocele, cystocele, and **rectocele** are considered along with pelvic floor relaxation in Chapter V. A less common type of swelling in the vagina is the **cul-de-sac hernia** (Figs. 430, 431) which is considered in detail under uterine prolapse with which it is usually associated. **Obturator hernia** and other rare types of swelling, such as **pelvic lipoma,** must be kept in mind when making differential diagnosis of an uncertain soft mass in the vagina.

Endometriosis of the posterior peritoneal cul-de-sac involving the vaginal wall in that region presents the same features as endometriosis elsewhere. Figs. 436 and 437 show the microscopic features by low power and high power. Papillomas and also fibromas occur occasionally in the vagina.

Fig. 436.—Endometriosis of the rectovaginal septum. On the right edge is seen the squamous epithelium of the vagina and on the left edge is an endometrial gland deep in the muscle. Gyn. Lab.

Solid tumors (fibroma, myoma, adenomyoma) occasionally develop in the vaginal wall. Such a tumor may be mistaken for hernia, rectocele, cyst, or a malignant tumor. Solid tumors in this situation are so rare as to require no detailed consideration, but the possibility of their existence must be kept in mind when endeavoring to determine the character of the swelling in this region.

Vaginal cysts are not especially uncommon. Since the vagina normally contains no glands, the question of the origin of the cysts is naturally of interest. Most pathologists feel that they are remnants of Gärtner's duct, carried over from embryonic life. The cysts are usually small and are rarely of importance, but occasionally they become very large. Frank has reported a case of large multiple vaginal cysts accompanied by large varicosities requiring cesarean section for delivery. Microscopically, the lining of these cysts may be low cuboidal epithelium or there may be several types of lining cells: ciliated, nonciliated, columnar, or squamous. Vaginal cysts are shown in Figs. 438 to 441. In some cases the vaginal wall is separate from the cyst and moves freely over it, while in other cases the vaginal wall is closely adherent to the cyst, apparently forming part of it.

The contents of the cyst may be like serum or may be milky or may be dark and thick, the color and consistency depending on the amount of hemorrhage into the cyst cavity.

Diagnosis.—The cyst differs from vaginal HERNIA in that it is of gradual development without apparent cause, gives, on coughing, no impulse separate from that of the adjacent vaginal wall, cannot be reduced, and is not associated with intestinal disturbance. The cyst differs from vaginal ABSCESS in that inflammatory symptoms are absent. In some cases, infection of the cyst contents takes place and the cyst becomes an abscess. In such cases it is distinguished from a simple abscess by the presence of a swelling long before the inflammatory symptoms developed. In some cases a swelling that appears to be a vaginal cyst is simply a pocket from the urethra (suburethral abscess).

A. *B.*
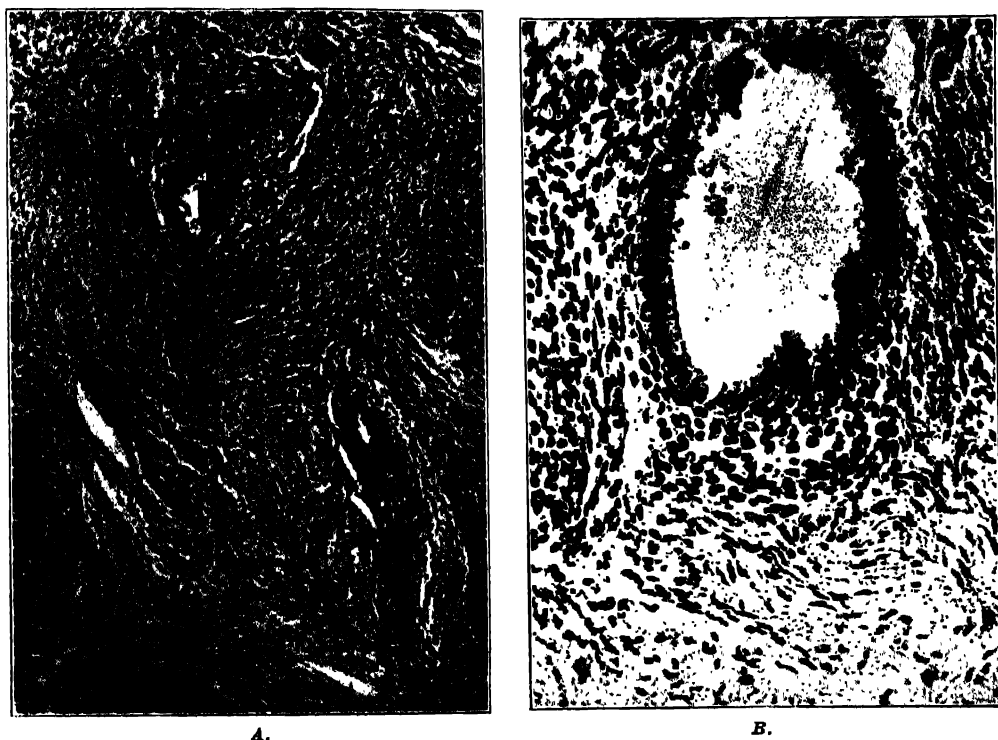
Fig. 437.—Endometriosis of rectovaginal septum. The tumor was a small nodule about 1 cm. in diameter and was removed by vaginal incision. *A*, Shows smooth muscle in which are embedded glands surrounded by a definite mantle of stroma. *B*, High power, showing gland with surrounding stroma and muscle. Gyn. Lab. (Schwarz—*Trans. Am. Assoc. Obst. and Gynec.*)

Two other conditions that should receive attention in the differential diagnosis of vaginal cyst are: double vagina and double ureter. In a case of **double vagina,** the second vagina may be completely shut off and filled with old menstrual blood. It would usually be somewhat larger and less tense than the ordinary vaginal cyst, though the latter is frequently of considerable size. There would be double uterus and the relation of the mass to the uterus would point to one-sided hematocolpos. From **hydroureter** or a **supernumerary ureter,** the differentiation would also be rather difficult and depend principally on the shape and tension of the swelling. In a case of double ureter, if one ended blindly alongside the vagina and became distended with urine, it would form

a mass which would be more sausage-shaped and have less tension than a vaginal cyst. A puncture of the mass with an aspirator needle, of course, aids greatly in differentiating between these conditions—the presence of blood speaking for hematocolpos, and of urine for hydroureter.

Fig. 438.　　　　　　　　　　　　　　Fig. 439.

Fig 438.—Cyst of vaginal wall arising from Gaertner's duct. (Ingraham—*J. A. M. A.*)

Fig. 439.—Dermoid cyst of vagina which has ulcerated into bladder. (Quinby—*J. A. M. A.*)

Fig. 440.　　　　　　　　　　　　　　Fig. 441.

Fig. 440.—A group of small cysts of the vaginal wall. (Montgomery—*Practical Gynecology.*)

Fig. 441.—A small cyst of the vaginal wall. (Hirst—*Diseases of Women.*)

Hernia must be carefully excluded before aspirating, or fatal peritonitis may result. If it is intended to remove the cyst by operation, only a small amount of fluid should be removed for diagnostic purposes, for the extirpation is more easily carried out when the cyst is distended than when collapsed.

Treatment.—If the cyst is large and troublesome, the most satisfactory way of dealing with it is by extirpation, provided it is situated in the lower part of the vagina where complete extirpation is practicable. A cyst due to remains of Gärtner's duct may extend up into the broad ligament, a point to be kept in mind in attempted removal. If a cyst is so situated that it cannot be completely extirpated, remove a large part of the wall, curette the remaining portion, pack with gauze, and treat as an abscess cavity. If the patient is averse to operation, the cyst may be simply emptied by aspiration. There is a possibility that it will remain collapsed for some time or even permanently. The probability, however, is that it will refill in a short time and that extirpation will be necessary.

If the cyst is first discovered during pregnancy, do not disturb it until labor begins. When labor comes on and the child's head is beginning to press into the pelvis, empty the cyst with an aspirator, to give room for the passage of the child. Do not attempt extirpation of the cyst or incision and drainage until the patient has recovered from parturition.

MALIGNANT DISEASE OF THE VULVA

Cancer of the external genitals includes carcinoma (usually of the squamous-cell type), chorioepithelioma, and sarcoma.

Carcinoma of Vulva

Carcinoma of the vulva is found in about 3 per cent of cases of cancer of the genital tract. The relative frequency of vulvar cancer to uterine cancer varies in different series from 1 to 20 to 1 to 30. The greatest incidence of cancer of the external genitals is between the ages of sixty and seventy, but

Fig. 442.

Fig. 443.

Figs. 442 and 443.—Carcinoma of vulva starting on a leucoplakic base. Fig. 442 is a microscopic section, low power, showing the leucoplakic vulvitis and the carcinoma. Fig 443 is high power of the margin of the invading carcinoma (at the right). (Eden—*Trans. Am. Gyneo. Soc.*)

it may occur at any age. Taussig found that leucoplakic vulvitis was a precursor of the cancer in 50 per cent of the cases in the large series he reported. Examples of origin from the chronic irritation of leucoplakic vulvitis and of condyloma are shown in Figs. 442 to 446.

Taussig classifies carcinomas of this region into four groups, based on the point of origin, as follows: 1. Epidermal cancer, springing from the skin. Its most frequent site is the prepuce. Microscopically it is evident that the growth is a skin cancer. The characteristics are shown in Figs. 447 and 448. 2. Carcinoma of the clitoris. This is a subdermal tumor of extreme malignancy. Histologically the cells resemble sarcoma cells.

Fig. 444.—Leucoplakic vulvitis with beginning carcinoma. The leucoplakia is in the stage of epithelial hypertrophy which precedes marked atrophy. This is an excellent example of a squamous carcinoma beginning on a leucoplakic base. Gyn. Lab.

Fig. 445.

Fig. 446.

Figs. 445 and 446.—Carcinoma of clitoris starting from condyloma. Fig. 445 is a microscopic section, low power, showing condyloma and carcinomatous area. Fig. 446 is high power showing the edge of the invading carcinoma. (Taussig—*Trans. Am. Gynec. Soc.*)

3. Vestibular cancer, arising usually from the urinary meatus. Histologically it reproduces the tissue from which it springs. 4. Bartholin gland carcinoma.

Epithelioma is the most frequent form. This begins usually on the lower portion of the labium majus as a small hard nodule with a bluish tinge, especially about the edge. The nodule grows slowly and at first may produce no symptoms. In some cases, however,
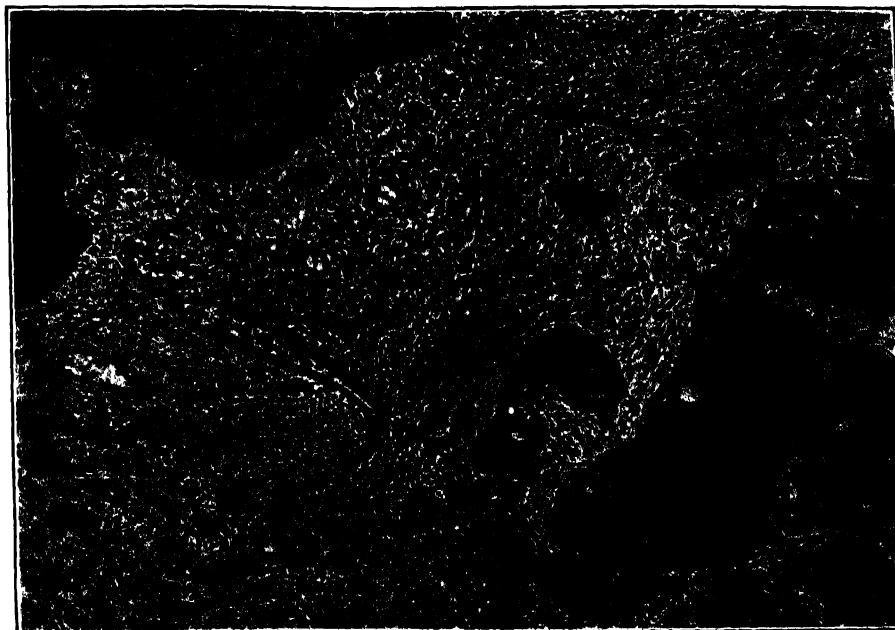
Fig. 447.—Carcinoma of the vulva. High power, showing a portion of the leucoplakic epithelium above and a nest of carcinoma cells below and to the right. Gyn. Lab.

Fig. 448.—Carcinoma of the vulva. Higher power of the nest of carcinoma cells, showing the variation in size, mitoses, and pearl formation. Note the round cell infiltration at the periphery. Gyn. Lab.
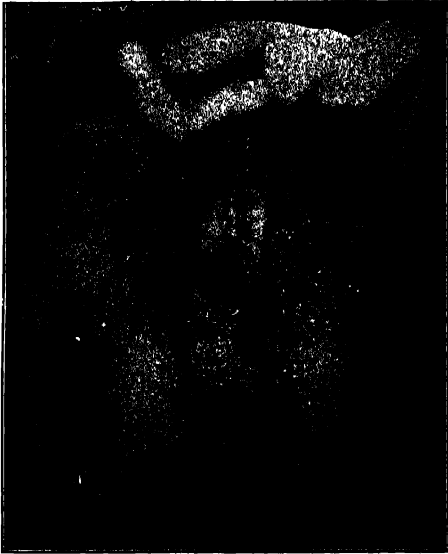
Fig. 449.

Fig. 450.

Fig. 449.—An epithelioma of the right labium.   (Hirst—*Diseases of Women.*)
Fig. 450.—Carcinoma of labium minus, beginning.   (Hirst—*Diseases of Women.*)
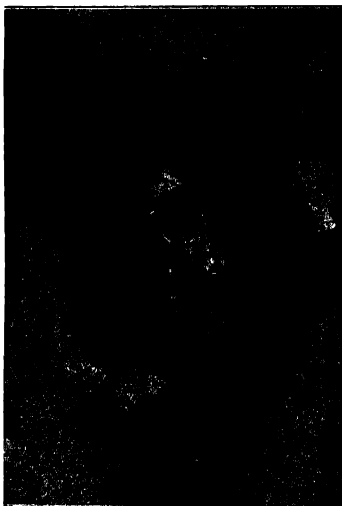
Fig. 451.
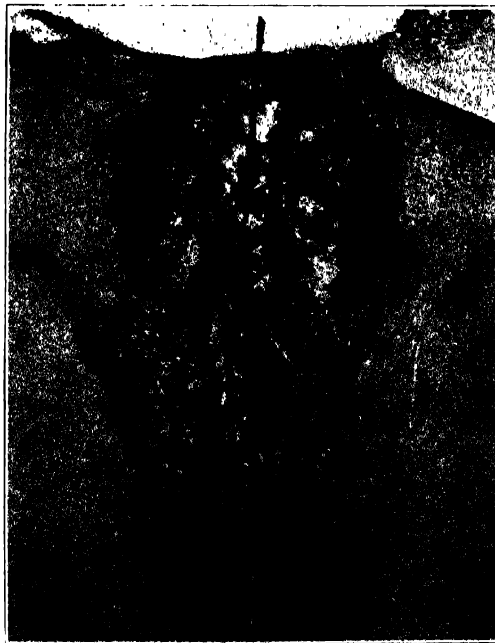
Fig. 452.

Fig. 451.—An epithelioma of the clitoris.   (Hirst—*Diseases of Women.*)
Fig. 452.—Carcinoma of clitoris, starting from condyloma.   (Taussig—*Trans. Am. Gynec. Soc.*)

even from the first there is severe pruritus. After a time, part of the nodule breaks down, forming a small ulcer which is surrounded by an area of induration (Figs. 449 to 454). There is a watery discharge sometimes mixed with blood. It may begin in the labium minus (Fig. 450) or in the clitoris (Fig. 451). After the malignant induration breaks down and ulcerates, the progress is rapid. The adjacent surfaces become involved in the destructive process, and in the later stages a large fungating mass may form.

The relation of chronic vulvar irritation, particularly leucoplakic vulvitis, to the origin of cancer is indicated in the illustrations.

The inguinal glands become enlarged early, at first simply from the lymphatic enlargement that always takes place when there is inflammation or persistent irritation of the genital region. Later the glands become infiltrated with cancer cells and often are greatly enlarged. In the later stage the carcinomatous glands break down and ulcerate externally.

Fig. 453.   Fig. 454.

Fig. 453 and 454.—Two patients with carcinoma of the vulva starting on a base of leucoplakic vulvitis. (Taussig—*Trans. Am. Gynec. Soc.*)

Carcinoma of the vulvovaginal gland is shown in Figs. 455 to 459. If originating in the duct it is of the squamous-cell type; if in the gland, of the cylindrical-cell type. Rothchild reported an incidence of 17 cancers of this gland in 395 vulvar cancers (4 per cent), while Taussig found 4.5 per cent in his personal series of 89 cases of vulvar cancer. The vulvovaginal gland carcinoma has reached an unusual size before breaking down by ulceration. The very rapid growth in pregnancy is shown in Figs. 458 and 459.

Diagnosis.—The patient may suffer from burning and superficial pain in the early stages and later there may be severe pain from involvement of the deeper structures. Carcinoma of the clitoris has been observed, and may be melanotic. The urinary meatus is another site where cancer occasionally de-

velops after long-continued irritation; and in any persistent infiltration there, this condition should be considered. In all of these forms of growth, treatment in a very early stage gives the only probability of cure. Consequently, in the case of a suspicious ulcer or nodule in which the diagnosis remains doubtful after careful treatment for a short time, a piece of the margin of the area should be excised for microscopic examination.

Fig 455.   Fig. 456.

Figs. 455 and 456.—Carcinoma of vulvovaginal gland. Fig. 455, gross appearance, Fig. 456, microscopic, low power. (Davis—*Tr. Am. Assn. Obst. and Gynec.*)

Fig. 457.—A large carcinoma of the left vulvovaginal gland. (Kelly—*Operative Gynecology.*)

Treatment.— Early and wide excision with adjacent gland removal is the treatment to employ in operable cases. Taussig from his special study and large experience with vulvar cancer gives in a recent article the following conclusions:

1. Early recognition and prompt adequate treatment are extremely rare in cancer of the vulva. In spite of this the disease, because of its relatively slow growth, offers a reasonably good prognosis.

2. Prevention of carcinoma of the vulva by early excision of the leucoplakic vulva should materially lower the incidence of the disease.

3. Radiologic treatment of the disease gives disappointing results, and is usually attended by painful burns.

4. The complete modified Basset operation gives splendid results in patients with operable lesions who are under sixty-five years of age. In older patients only those in better than average physical condition with relatively early lesions should be subjected to this procedure.

5. Approximately two-thirds of the cases of cancer of the vulva are still operable at the first examination. In those in whom a Basset operation is done we can expect a five-year survival in about three out of five, even though two out of five already show evidence of lymph gland metastasis.
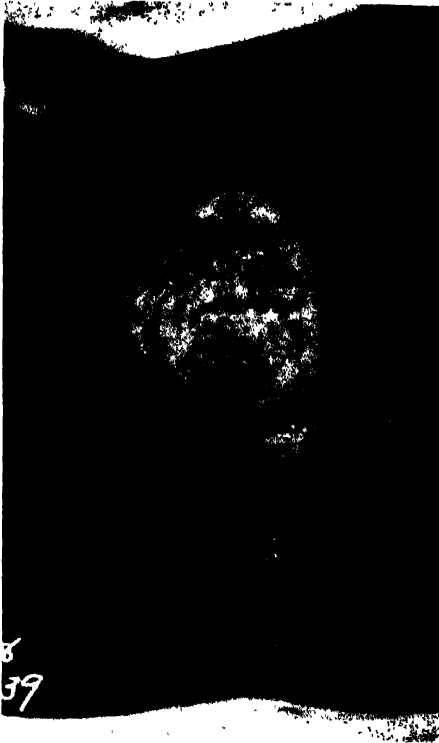
Fig. 458.   Fig. 459.

Fig. 458.—Carcinoma of the vulvovaginal gland, with a seven-month pregnancy.

Fig. 459.—Two months later, showing the very rapid growth during pregnancy. (Penick—Personal Communication)

Prevention.—As such a large proportion (50 per cent) of cases of vulvar cancer are preceded by leucoplakic vulvitis or other form of chronic irritation, the matter of possible prevention assumes much importance. On this point, Taussig concludes as follows:

I am convinced that we have been very remiss in our preventive measures in the past. The incidence of vulvar carcinoma might very possibly be cut in half, if we would adopt the following measures:

1. A complete vulvectomy in cases of well-developed leucoplakic vulvitis, and rigid supervision, at least twice a year, in milder cases where the patient refuses operative treatment.

2. Intensive antisyphilitic treatment in tertiary lesions of the vulva, especially in negroes.
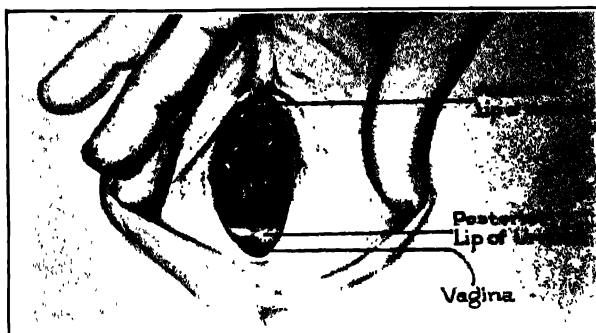
Fig. 160.—Melanosarcoma of urethral meatus. Labia spread apart exposing the tumor. (Newell and Scrivner—*Am. J. Obst. & Gynec.*)

Fig. 461.—Melanosarcoma of urethral meatus. Low power, showing the tumor beneath the squamous epithelium, taken from Fig. 460. (Newell and Scrivner—*Am. J. Obst. & Gynec.*)
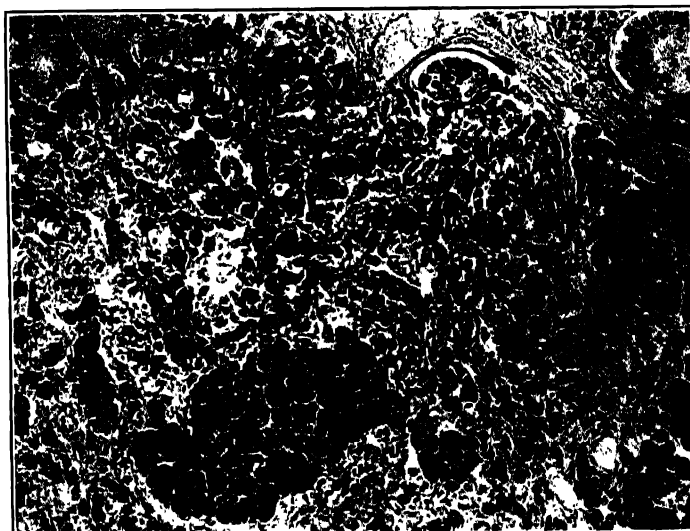
Fig. 462.—Melanosarcoma of urethral meatus. Higher power of Fig. 461, showing the malignant melanoma cells. (Newell and Scrivner—*Am. J. Obst. & Gynec.*)

3. Removal of vulvar warts in women past the menopause.

4. Close observation or excision of enlarged Bartholin glands in women over forty years of age.

5. Cautery excision or radiant treatment of urethral caruncles.

Particularly in leucoplakic vulvitis would I stress the advantages of surgery over nerve resection or treatment with ovarian hormones. The latter undeniably often decreases the pruritus, but the question whether the use of such carcinogenic substances may not at times predispose to the development of a cancer might very well be raised.

Sarcoma of Vulva

Sarcoma may arise as a tumor of the subcutaneous tissue in the vulva the same as elsewhere on the body, or it may result from malignant changes in a fibroma. The age incidence is much younger than for carcinoma. These tumors are very malignant and are rarely cured.

Melanosarcoma is an especially malignant type. One arising from the region of the meatus is shown in Figs. 460 to 462.

The treatment of sarcoma of the vulva is the same as for carcinoma.

MALIGNANT DISEASE OF THE VAGINA

This occurs in three forms: namely, ordinary carcinomas (epithelium, adenocarcinoma), choriocpithelioma which is a form of carcinoma but is derived from fetal tissue instead of from the mother's tissue, and sarcoma.

Carcinoma of Vagina

Carcinoma of the vagina is usually secondary (Fig. 463) to carcinoma of the uterus or rectum or bladder or external genitals, and the treatment depends on the location and extent of the principal lesion. Primary carcinoma of the vagina (Fig. 464) is rare.

Squamous-cell (epithelioma) is of course the usual form. It appears as a papillary or nodular condition, usually first at the vaginal vault and later spreads downward toward the opening. The usual origin at the posterior fornix fits in well with acceptance of chronic irritation as an etiological factor, for this is the site of chronic irritation from retained discharge and also from pressure of pessary when it causes irritation.

In primary cancer of the vagina, as in cancer elsewhere, a positive diagnosis in the early stages must rest upon microscopic findings in an excised piece. The treatment is complete extirpation, if seen early enough, followed by x-ray therapy. The results thus far have been unsatisfactory. There is usually recurrence. If at all advanced, radium followed by x-ray is the preferable form of treatment.

CHORIOEPITHELIOMA.—This variety of carcinoma sometimes occurs in the vagina, representing an early metastasis. This curious form of tumor will be considered in greater detail under Malignant Disease of the Uterus. It arises from chorionic villi and may develop after normal parturition or after abortion or after mole-pregnancy. It usually develops in the uterus, but occasionally one of the chorionic villi transported to the vagina (pieces of chorionic villi are normally transported to various parts of the body in probably all pregnancies) takes on the peculiar change and forms a malignant growth. As it

grows, it breaks into the veins, and particles are carried to the lungs and form metastases there. Hence the advisability of x-ray examination of the lungs in any case of suspected chorioepithelioma. Occasionally the lung symptoms are the first noticed. Since such a growth in the vagina or in the vulva is usually metastatic from a similar growth in the uterus, the condition of the uterus should be investigated.

Fig. 463.

Fig. 464.

Fig. 463.—Secondary malignant ulceration of the vagina. In this case there was a carcinoma of the endometrium, and the discharge caused an implantation carcinoma where the cervix came in constant contact with the posterior vaginal wall. (Kelly—*Operative Gynecology.*)

Fig 464.— Primary malignant ulceration of the vagina. (Montgomery—*Practical Gynecology.*)

Sarcoma of Vagina

One form in which sarcoma of the vagina occurs, is as a diffuse infiltration and degeneration of the lining membrane. This is the form sometimes found in young children. It occurs most frequently in the posterior vaginal wall. It begins as a small indurated area which slowly increases in size. After a time the epithelium covering the area is lost and an ulcer forms. The ulcer bleeds easily and is surrounded by an area of induration. A large part of, or even the entire circumference of, the vagina may become involved in the sarcomatous infiltration, which may be mistaken for carcinoma or tuberculosis. In another variety grapelike masses form in the vagina and may project outside, as in the case shown in Figs. 465 to 467. The treatment for sarcoma of the vagina is the same as for carcinoma.

Mixed tumors of the vagina, also called sarcoma botryoides, have been reported. They occur usually as a polyp on the anterior wall of the vagina, either present at birth or appearing shortly after birth. When removed they promptly recur and enlarge. They occur almost exclusively in children and sometimes do not exhibit their malignant qualities until after puberty. Microscopically there is a marked variation in the findings. Myxomatous tissue, striped and unstriped muscle, giant cells, round cells, and cartilage are some of the components found.

The symptoms of sarcoma of the vagina are leucorrhea, hemorrhage, pain, and obstruction of the vagina by the infiltration. Slight hemorrhage may appear in the early stages, particularly after coitus or exertion. In the late stages, profuse hemorrhages occurs, and there is also a mucopurulent or watery

Fig. 465.   Fig. 466.

Fig. 465.—Sarcoma of vagina in child, aged five years. This specimen protruded from the vagina as a reddened cauliflower mass. Microscopic diagnosis, myosarcoma.

Fig. 466.—Microscopic section of specimen shown in Fig. 465. Low power. Gyn. Lab.

Fig. 467.—Microscopic section of specimen shown in Fig. 466. High power, showing the margin of one of the grapelike masses. Gyn. Lab.

discharge that may cause pruritus. The pain is slight at first but gradually increases in severity. It is usually worse at night. Examination reveals a nodular tumor or an area of induration or ulceration and more or less narrowing or obstruction of the vagina, and a microscopic examination shows the nature of the mass. The treatment is the same as for carcinoma.

MISCELLANEOUS DISTURBANCES

The miscellaneous disturbances of the external genitals and vagina include leucoderma (vitiligo) of the vulva and vicinity, adhesions of prepuce, adhesions of labia, hyperesthesia of vaginal entrance, and pruritus vulvae.

Fig. 468.   Fig. 469.

Fig. 468.—A case of adherent prepuce, the clitoris being entirely hidden. (Kelly—*Operative Gynecology.*)
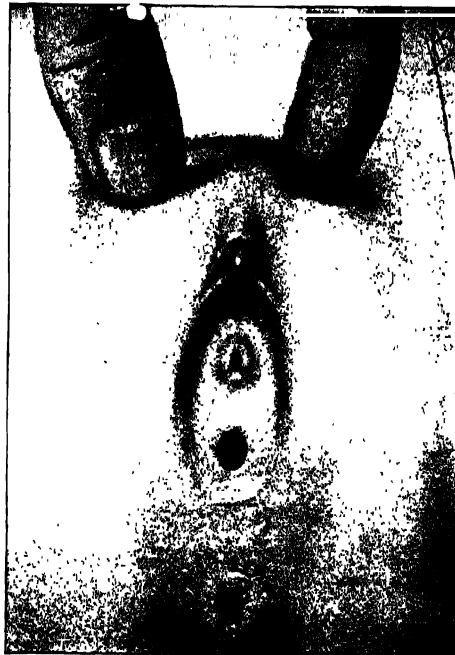
Fig. 469.—The same case, with the adhesions separated and the prepuce pushed back and the clitoris exposed. Notice the smegma concretions which had formed under the adherent prepuce. (Kelly—*Operative Gynecology.*)

Leucoderma of Vulva

Leucoderma or vitiligo is a condition characterized by the loss of pigment in certain areas of the skin. As the term signifies, the skin is simply whitened. There is no infiltration nor stiffening nor hypersensitiveness. The skin of the affected areas retains its normal softness and flexibility, the only appreciable change being the loss of color. It may affect only a small area or may be extensive, with perhaps areas elsewhere on the body.

As there are no symptoms, local or general, the condition is seldom of clinical importance. It should, however, be watched to make certain that the small white area is not part of a developing leucoplakic vulvitis.

Adhesions of Prepuce

Not infrequently in infants, adhesions are found between the glands of the clitoris and the prepuce. In some cases the adhesions are extensive (Fig. 468) and much irritation is produced by retained secretion, not so rarely forming the underlying cause for the habit of masturbation acquired by a child. In such a case the adhesions should be separated. After applying a local anesthetic solution for five minutes, the adhesions are broken, the glans thoroughly exposed as in Fig. 469, and then the parts coated with some bland ointment, such as zinc oxide or vaseline.

Adhesions of Labia

The labia minora are occasionally found adherent. This condition may be congenital or acquired. In the latter case, the cause is inflammation or ulceration of various kinds, producing raw surfaces which come in contact and grow together. The adhesions are usually found in the unmarried, and especially in children and in the aged, when considerable irritation may persist without attracting notice. The adhesions between the labia are easily broken if recent, but later the adherent surfaces become firmly united by connective tissue and can be separated only with a knife. The treatment, when the adhesions are recent and weak, is to break them with a probe or other blunt instrument, separate the labia and keep them apart with pledgets of cotton. Treat the affected surfaces as indicated by the inflammation or ulceration present. When the adhesions are old and firm, the parts may be separated with the knife or scissors, or the line of union, with some of the thickened tissue on each side, may be excised. Sutures are then introduced to check the hemorrhage and close the raw surfaces.

Hyperesthesia of the Vaginal Entrance

The structures surrounding the vaginal orifice may be so hyperesthetic that coitus is very painful and in some cases impossible. Occasionally the parts are so tender and the nervous irritability so marked that attempts at sexual intercourse cause a spasm of the muscles surrounding the vaginal opening, including the levator ani. This spasmodic condition is known as "vaginismus."

There may be also a definite stenosis of the vaginal entrance due to rigidity of the hymen or adjacent tissues and making the opening so small that normal coitus is not possible and attempts cause pain.

Causes.—Hyperesthesia of the vaginal entrance occurs most frequently in nervous young women, newly married, or in women near the menopause. The cause of this marked hypersensitiveness may be as follows: (a) Urethral caruncle or inflammation about the meatus or along the urethra. (b) Painful fissures about the vaginal orifice or about the anus. (c) Inflammation of a rigid hymen or remnants of a hymen. (d) Neuromas on remnants of the hymen. (e) Neuroses. In some cases, especially in women near the menopause, the hypersensitiveness of the nerve endings is apparently due to atrophic thinning of the protective epithelial covering, which indicates treatment as for atrophic vaginitis. (f) Organic stenosis.
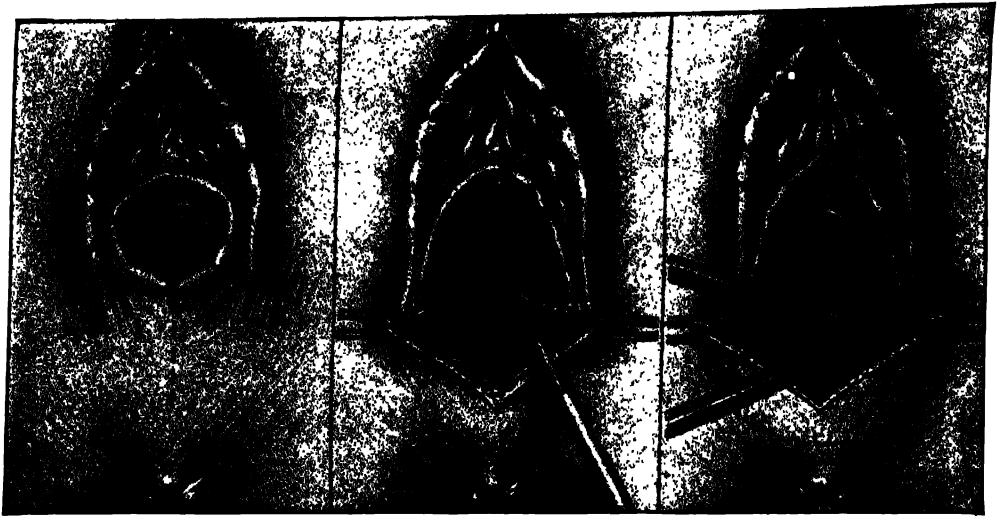
Fig. 470.   Fig. 471.   Fig. 472.

Fig. 470.—Open enlargement of the stenosed vaginal entrance. The broken line indicates the line of incision, which in severe cases should extend to the region of the sphincter ani, but of course taking care to stop short of that muscle.

Fig. 471.—The perineum has been divided, and the deep resisting levator sling is being incised. This incision of the levator muscle is to be made on each side and is to be extended deeper, step by step, as testing shows necessary to give a very wide opening. The opening must be enlarged sufficiently to allow for some subsequent spasmodic narrowing, for the tendency to spasm cannot be entirely overcome.

Fig. 472.—The skin flap is loosened by undermining, as indicated by the dotted line, and the mucous flap is likewise loosened. This loosening of the flaps should be sufficiently extensive to allow them to be brought together (Fig. 474) without much tension. In order to cover the raw surface without undue tension in severe cases it may be necessary to shift formed flaps of skin or mucosa, the incisions for forming each flap being so placed that the uncut base carries the regular blood supply.

The free bleeding from division of the deep tissues is controlled first by forceps, and then each forceps-bite is caught with a suture-ligature of chromic catgut. All approximation should be in an anteroposterior direction, as indicated in Figs. 471 and 472. Side to side narrowing must be carefully avoided. (Crossen and Crossen—*Operative Gynecology*.)
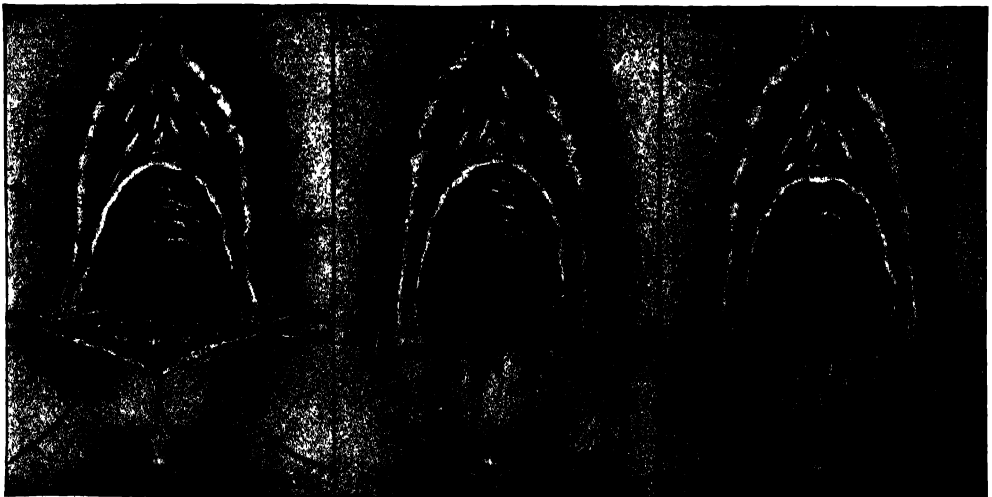
Fig. 473.   Fig. 474.   Fig. 475.

Fig. 473.—All bleeding should be controlled and the deep tissues fully approximated, as here shown, before the superficial flaps are sutured together. Secure approximation of the deep tissues in their new relations tends to lessen the tension on the superficial flaps.

Figs. 474 and 475.—If tension-sutures are used as here indicated, they may be of black silk, heavy catgut, or kangaroo tendon. (Crossen and Crossen—*Operative Gynecology*.)

Treatment.—The treatment may be presented in the following steps:

1. Reduce the general nervous irritability by sedatives and relieve the pelvic congestion by laxatives if needed, and attention to other possible causes of undue pelvic congestion.

2. Remove all local lesions that cause irritation. Abrasions, fissures, and areas of inflammation must be made to heal. The various therapeutic measures for these conditions have been described.

3. Employ local sedative applications and stretching. Hot douches usually diminish the sensitiveness of the parts, and also the various soothing measures mentioned under Vulvitis and Pruritus may be employed. In some cases of small opening or spasm, considerable relief may be given by moderate stretching treatments. When the trouble occurs in a young married woman, if temporary relief can be given, pregnancy may ensue with permanent cure of the stenosis and spasm after delivery.

4. Operative treatment. A rigid hymen that gives persistent disturbance despite stretching treatments requires to be incised or excised. Neuromas sometimes develop in remnants of the hymen, requiring excision. When there is stenosis or persistent spasm or a combination of the two seriously interfering with coitus, regular plastic operation for enlargement of the opening is indicated.

In the severe cases, especially if the spasmodic element is decided, particular care must be taken to divide the anterior portion of the levator sling sufficiently to give a good wide opening—wide enough to permit some spasm and yet not interfere seriously with coitus. The division of the deep spasmodic levator sling may be made by incision in the median line and the cut spread so as to get at the levator sling in each side, as shown in Figs. 470 and 471, or a cut may be made in each sulcus. Whether median or lateral cuts are used, they are made large enough so that the division of the constricting levator sling may be made under direct vision, as shown in Fig. 471. After the opening has been widened to the extent previously mentioned, the bleeding is controlled by suture ligatures (Fig. 472) and the wound or wounds are closed (Figs. 473 and 474). Particular care must be exercised in placing the suture-ligatures for hemostasis and approximation, to avoid narrowing of the enlarged opening. All tension and approximation should be in the longitudinal axis of the vagina and none transversely. To secure this approximation as shown in Figs. 473 and 474, flaps should be raised on both the mucous and the skin surfaces (see Fig. 475). As a rule, there will be some separation of the flap during healing because of the tension, which cannot be entirely eliminated. For suturing, chromic catgut, forty-day, No. 2, seems to do as well as any other material. It lasts for a fairly long time even on the mucous surface. Nonabsorbable sutures, such as silk or silkworm-gut would seem preferable, but experience shows that, with the unavoidable tension, they cut through so rapidly that the approximated flaps are released sooner than with the large-sized chromic catgut.

Pruritus Vulvae

Pruritus vulvae signifies simply itching about the external genitals, but by common usage the term has come to be restricted to those cases in which the itching and burning are marked and persistent.

Etiology.—The general nervous disturbances and the local atrophic changes that accompany and follow the menopause predispose to pruritus vulvae, hence the vast majority of cases are found in that period of life.

The following are the exciting causes:

1. AN IRRITATING VAGINAL DISCHARGE.—The discharge may originate in the vagina or in the uterus. Atrophic vaginitis, which occurs principally in the aged, is a frequent cause of pruritus vulvae. Sometimes a discharge which is so slight as not to be noticed by the patient will keep up a troublesome pruritus, the pruritus disappearing temporarily when the discharge is eliminated by douches.

2. IRRITATING URINE, for example, diabetic urine or highly acid urine, or pus-bearing urine due to inflammation of the bladder or kidney.

3. PARASITIC AFFECTIONS, which may be monilia or trichophytosis or pediculosis pubis. In children threadworms from the rectum may cause persistent itching.

4. SKIN DISEASES, such as eczema, follicular inflammation, and prurigo.

5. ENDOCRINE OR VITAMIN DEFICIENCY.

6. GROWTH OF SHORT BRISTLY HAIRS on the inner surface of the labia. These scratch and irritate the adjacent surface and sometimes cause very troublesome pruritus. Occasionally such irritation is caused by the short hairs present for some weeks after shaving the parts for an operation.

7. FRICTION from exercise, especially in very stout persons.

8. LEUCOPLAKIC VULVITIS.

9. CHRONIC CONGESTION, from diseases of the uterus or tubes or ovaries or other pelvic structures.

10. FUNCTIONAL NERVOUS DISTURBANCES.—In some cases, no cause for the disturbance can be found and apparently no local changes are present, aside from abrasions and irritation caused by scratching. Under such circumstances, careful search must be made for endocrine disturbances, and for allergic disturbances from articles of food or from contact substances.

Symptoms.—The patient complains of an intense itching about the genitals. It may be confined to the clitoris, labia or vestibule, or it may involve all these structures and also adjacent regions, for example, the vagina, anus, and inner sides of the thighs. The itching and burning may be practically continuous, but more often it is intermittent in character. It may disappear spontaneously for several hours or days or even longer, only to return as suddenly as it disappeared. Congestion at the menstrual period or during pregnancy may increase the pruritus. Irritating articles of food and also alcoholics often have the same effect. The warmth of the bed usually makes the itching worse, consequently the patient may lose much sleep.

Frequently the distressing symptoms persist in spite of local and general sedatives and in some cases they become intolerable, making the patient's life a burden to her. On account of the irresistible tendency to scratch or rub the parts, the skin becomes irritated and abraded and inflamed. Deep fissures may form and in some cases a discharging or weeping surface develops. The constant suffering makes the patient irritable and nervous and in some cases leads eventually to nervous prostration.

Treatment.—The treatment for pruritus vulvae may be presented in the following steps:

1. REMOVE ALL LOCAL CAUSES OF IRRITATION.—These have been enumerated under Etiology. If an irritating vaginal discharge is present, it must be stopped by appropriate treatment of the disease causing it. If that is not possible, the discharge may be kept from irritating the genitals by washing it away with antiseptic douches. Other causes of local irritation, such as diabetes, local skin diseases, and uterine or ovarian disease causing pelvic congestion, must receive appropriate treatment.
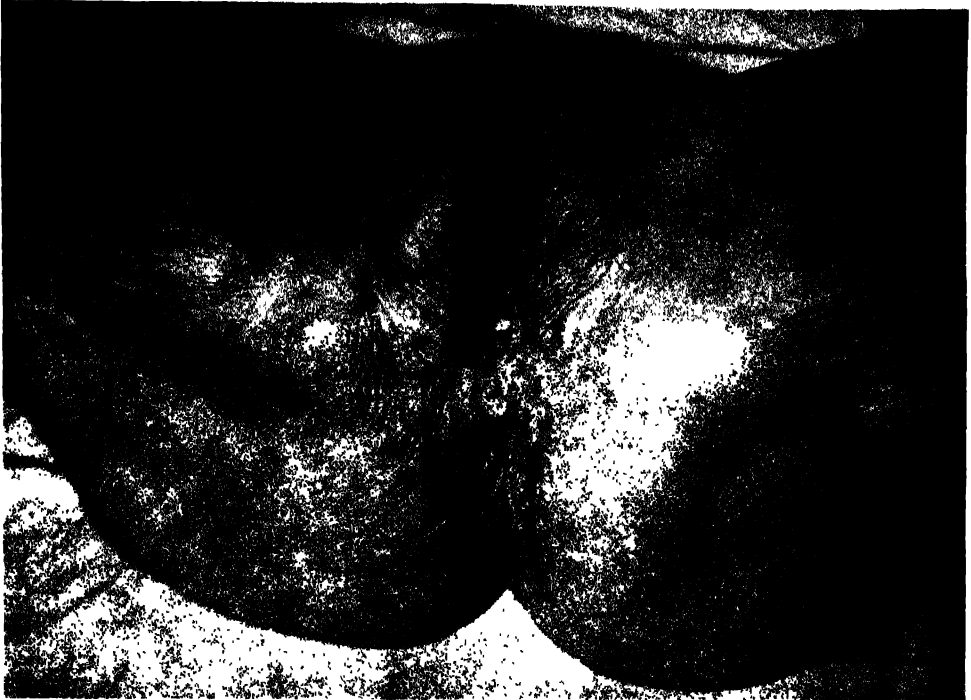
Fig. 476.—Pruritus and chronic dermatitis of the vulva and contiguous structures of two years' duration in a woman aged seventy years. For photographic purposes the site of each alcohol injection on the right was marked with indelible ink. Because of impaired circulation a minimum amount of alcohol (2 minims) was injected at wider intervals than usual. The multiple injections, thus depicted, relieved the pruritus promptly and caused the dermatitis to disappear within a week. Although there has been an occasional mild recurrence during the past three years, reinjection has not been necessary. (Wilson—*J. A. M. A.*)

2. EMPLOY LOCAL SEDATIVE APPLICATIONS.—The various sedative applications used for dermatitis and eczema may give considerable relief. Generally, the more free from discharge and moisture the parts are kept, the less irritation and discomfort. Hence, the frequent and liberal use of dusting powders. Some patients, however, obtain more relief from the use of a bland ointment and dusting the powder over that. Analgesic ointments give temporary relief. Carbolic acid of 1 per cent strength in ointment usually gives much relief, and with it may be incorporated other drugs for the particular skin conditions present; e.g., for trichophytosis or for various forms of eczema.

3. ATTEND TO THE GENERAL HEALTH.—Regulate the bowels so that any pelvic congestion from constipation is overcome. The patient must be put in

the best of general health, that the condition of the nervous system may be improved accordingly. This means complete investigation for lesions, and also for endocrine and vitamin deficiencies and allergic factors. Bacterin treatment is sometimes helpful, particularly that of the colon bacillus type.

4. X-RAY TREATMENT.—If the pruritus persists despite the measures mentioned, x-ray treatment may be employed for temporary effect. However, its use carries the danger of postponing curative treatment based on searched-out etiology, and also the danger of starting an x-ray dermatitis.

5. OPERATIONS.—If marked leucoplakic vulvitis is present, excision is required. In cases of persistent itching without apparent tissue change, and without endocrine or allergic cause, local injection treatment may be tried.

W. M. Wilson gives a most instructive report on the treatment of pruritus vulvae by means of subcutaneous injections of two to four minims of 95 per cent alcohol at many points over the involved area. Fig. 476 shows the points of injection on the right side in one case. Forty-nine cases of pruritus vulvae, most of them persistent in spite of other measures, were treated. The results attained were remarkable, and they indicate trial of this measure in persistent cases without removable cause. Full details of handling the patients are given in the article.

A. Jacoby reports a series of patients treated with local alcohol injections. Turell reports the successful treatment of recurrent pruritus, in adjacent areas after vulvectomy for leucoplakic vulvitis, by tattooing (puncturation) with mercury sulphide. Fantus and Cornbleet take up in a very thorough way the various features of pruritus treatment as it is carried out in the Cook County Hospital.

Resection of the nerves may be tried. The local nerve supply to the pruritic areas may be attacked by subcutaneous division immediately under the affected skin, or by division of the internal pudic nerve as it leaves the protecting tuberosity of the ischium. Care must be taken that the innervation of the rectum be not damaged, with resulting incontinence of feces.

RELAXATION AND FISTULAE

of the Pelvic Floor, Perineum, External Genitals, and Vagina

Points in Anatomy

The term "pelvic floor" is applied to that group of structures which closes in the pelvic outlet and supports the organs above it. The principal supporting structures are the levator ani muscles and associated fasciae. They are indicated diagrammatically in Fig. 477. The levator ani muscles, arising from each side of the pelvis and joining in the median line, form a sling which holds up the vagina and rectum and at the same time holds their lower ends forward under the pubic arch.
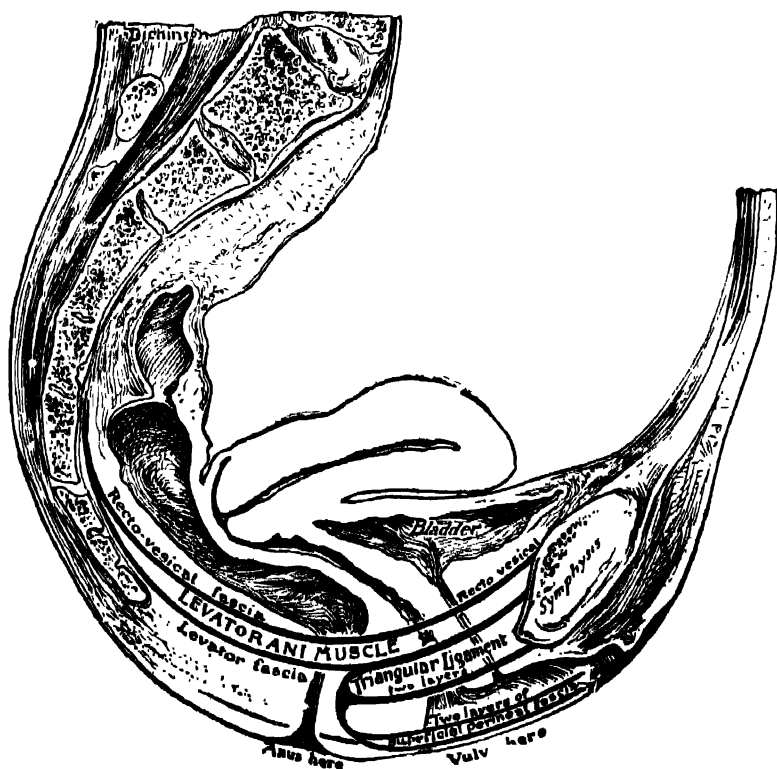
Fig 477.—A diagrammatic representation of an anteroposterior section of the pelvis, showing the various fascial layers of the pelvic floor. (Dickinson—*American Textbook of Obstetrics.*)

Each levator ani muscles arises in front from the posterior surface of the pubic bone, behind from the spine of the ischium, and between these points from the "white line" that marks the division of the pelvic fascia. The anterior portion of the muscle passes downward and toward the median line and unites with a corresponding portion of the muscle of the opposite side. Some of the fibers unite with the lower part of the vagina, some with the lower part
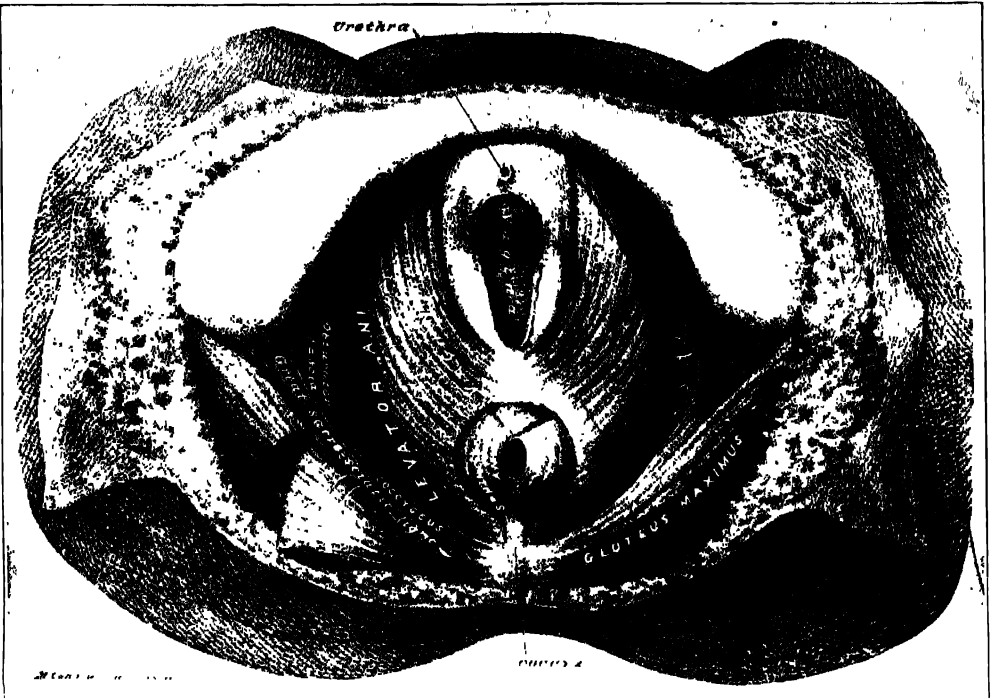
Fig. 478.—The superficial structures removed, exposing the levator ani and vaginae muscles. (Weisse —*Practical Human Anatomy.*)
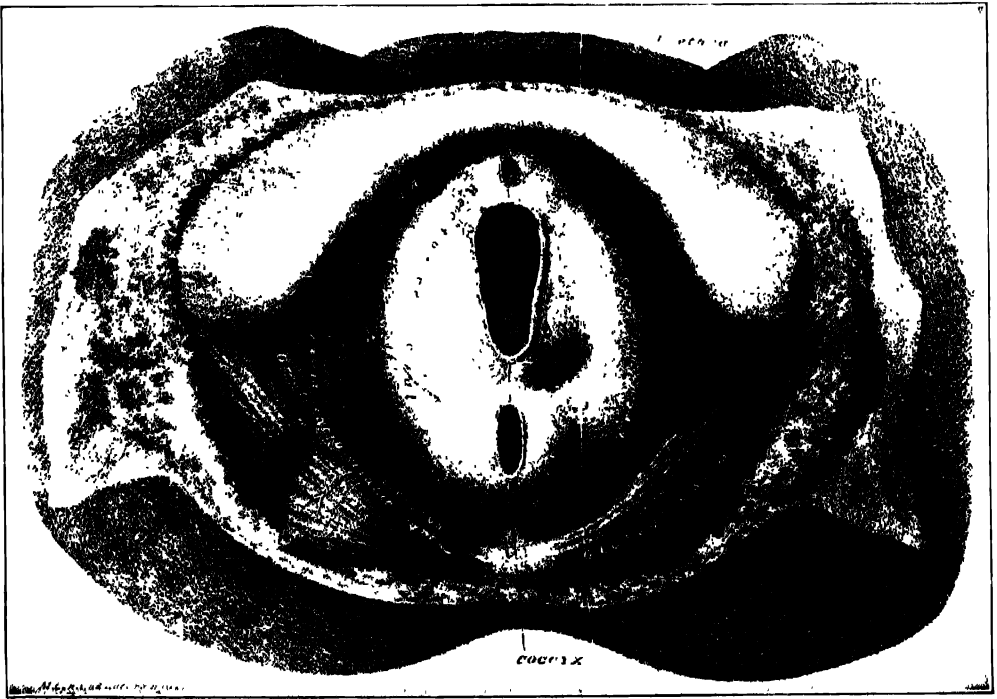
Fig. 479.—The levator ani muscles removed, exposing the strong rectovesical fascia. (Weisse—*Practical Human Anatomy.*)

of the rectum, some between the vagina and rectum, and many of them back of the rectum. The most posterior fibers of the muscle unite with the coccyx. Lying back of the posterior part of the levator ani muscle is the coccygeus muscle. The action of the levator muscles, in conjunction with the fascia above and below them, is to hold forward the lower end of the rectum and vagina close to the symphysis pubis, and at the same time to form a sling which closes the
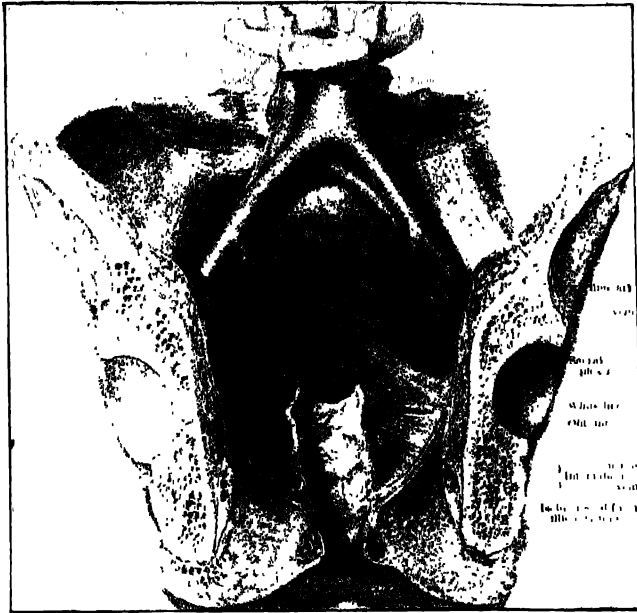
Fig. 480.—The pelvic sling. It is composed of the levator ani muscles and the fascia above and below them. Its attachment to the rectum is here shown but the vagina is not shown. (Kelly—*Operative Gynecology*.)
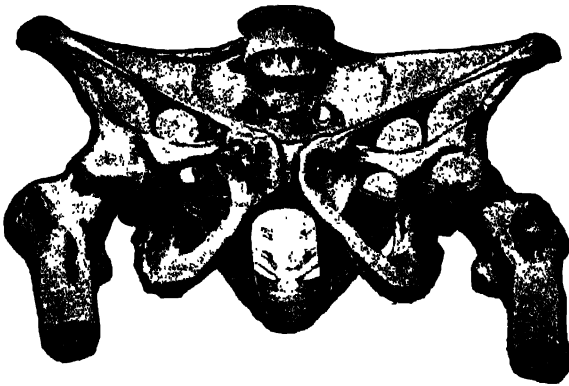
Fig. 481.

Fig. 482.

Fig. 481.—The pelvic sling, formed by the levator ani muscles. (Dickinson—*American Textbook of Obstetrics*.)

Fig. 482.—Actions of the pelvic sling. It tends to draw the vaginal opening and the anus forward under the pubic arch at the same time that it supports them. (Kelly—*Operative Gynecology*.)

pelvic outlet and supports the organs above (Figs. 478 to 482). Waldeyer has given this the very appropriate designation of "diaphragm of the pelvis."

When the muscles and fasciae are torn, the effect is twofold:

1. The sling is lengthened and does not furnish the support it previously did.

2. The vaginal and rectal openings (the weak places in the pelvic floor) are allowed to sink backward into the line of pressure, so that the weight from above, which formerly fell on the muscle and fascia, now falls on the openings.

The perineum is defined anatomically as the space at the pelvic outlet, its boundaries being formed by the bony and ligamentous margins. The soft structures closing this outlet are referred to collectively as the pelvic floor, the most important factor in pelvic floor support being the fibromuscular sling or diaphragm formed by the levator ani muscles and the fasciae immediately above and below them.

Fig. 483.　　　　Fig. 484.　　　　Fig. 485.

Figs. 483, 484, and 485.—Showing the perineal body, as seen on dissection and on cross section and with component parts labelled.

Several of the superficial muscles of the region meet at about the center of the perineal space, as shown in Fig. 483, and form there a rather firm body of tissue which lies between the lower end of the vagina and the rectum (Fig. 484). This is the perineal body, and the cross section in Fig. 485 indicates its structure. For convenience, the anatomical term "perineal body" is usually shortened to "perineum" in gynecological conversation and writings. Keeping in mind this gynecologic restriction when the term "perineum" is used should prevent any confusion with the strict anatomical definition as the entire space at the outlet of the bony pelvis.

Clinical and anatomical study have shown that the perineal body is not a large factor in pelvic support, the important supporting structures lying deeper, as above mentioned. Hence the expression "repair of perineum" is not a satisfactory descriptive term for repair of the supporting structures of the pelvic floor.

RELAXATION OF THE PELVIC FLOOR

For this common gynecologic condition, so frequently requiring operation, the authors prefer the term "relaxation" rather than "laceration," for the following reasons:

a. It is the presence or absence of relaxation that determines the necessity for treatment. Even though there is immediate repair and perfect healing of the laceration, there may, through subinvolution and lack of tone, be persisting relaxation requiring operation. Again, with an unrepaired laceration, the contraction of scar tissue and regaining of tone

may be sufficient to give good support, and there is no relaxation—hence, no cause for operation. The essential lesion, then, considered from the therapeutic standpoint, is the relaxation.

b. The term "laceration" as commonly used, and as interpreted by the patient, often works an injustice to the physician who took care of the patient during confinement. In a considerable proportion of cases the patient comes to the gynecologist with her mind poisoned against her former physician because some other physician has told her, bluntly and without qualification, that her present trouble is due to having been "torn in labor." The average patient interprets this as conclusive evidence of faulty care. In fact, she not infrequently begins her story with the statement that her trouble is due to neglect in confinement—this she knows because of having been informed that she was suffering from "a laceration."

Now, as a matter of fact, this wholesale condemnation is not warranted. Of course, in some cases the relaxation, for which the patient seeks relief, is really due to the fact that an extensive tear was not repaired at all or was repaired in a faulty manner. In a considerable proportion of the cases, however, the relaxation is due to entirely different causes. There may have been no open laceration, the overstretching having been accomplished by submucous lacerations (many or few) which could not even be located, much less repaired. Again, if pelvic floor involution is imperfect, as it often is in atonic patients, marked relaxation may result without there having been any definite alcerations, either open or submucous. This form of relaxation is especially likely to occur if the patient has repeated pregnancies at short intervals. Again, in certain cases, laceration or division of tissue must necessarily accompany delivery of the child. The wounds may fail to heal satisfactorily in spite of the utmost care. Again, a pelvic floor which is good two months after labor may be found greatly relaxed later, owing to displacement of the uterus or to heavy lifting (as of a heavy child) or to persistent straining or coughing associated with an atonic condition of the tissues. These facts are well known to every physician who has made a real study of the anatomy of the pelvis and of the physiology and pathology of parturition.

In view of the above facts, it is incumbent upon us to employ some term, for the condition under consideration, which does not in itself carry condemnation to the mind of the patient. "Relaxation" is such a term. It simply designates clearly the condition demanding relief, leaving open the question as to which one of the above-mentioned causes may have been present in that particular case.

Etiology

The usual cause of relaxation of the pelvic floor and perineum is **childbirth.** As the child's head passes through the pelvic outlet, the structures are greatly stretched and there is frequently more or less laceration (Figs. 486, 487).

Subinvolution is a large factor. The markedly enlarged uterus and vagina and pelvic floor accompanying pregnancy and parturition must undergo the normal process of involution. If this process is not completed there remains an atonic relaxed condition. While subinvolution of the uterus is often mentioned, subinvolution of the vagina and pelvic floor is seldom thought of, though it is no doubt an important factor in many cases of relaxed floor.

An allied factor is the general atonic condition of many patients, which tends to retard normal involution and restoration of local tone after childbirth. Also, after repair, an atonic condition may permit restretching of the healed tissues.

Prophylaxis.—In a fresh laceration of the pelvic floor or perineum in labor, the rule is to repair the injury at once. Even though the tear is not deep enough to damage the pelvic floor, it should be repaired, for every laceration closed lessens to that extent the chance of infection. For the same reason,

tears of the anterior vaginal wall or of the vulva should be repaired at once. The details of this immediate repair belong to obstetric work, and need not be considered here.

To prevent subinvolution, certain steps in addition to surgical repair are employed in postpartum care; namely, knee-chest posture (to keep the heavy uterus forward and improve the circulation about it), special exercises to improve local muscular tone, and a general tonic regimen with frequent periods of recumbent rest to relieve the pressure and strain on the involuting structures. The knee-chest posture and special exercises must not be employed too soon after labor. See Chapter III.

Fig. 486.—Recent lacerations in labor. *A*, Laceration involving the perineum and extending up the right vaginal sulcus. *B*. More severe laceration, involving the perineum and extending up both vaginal sulci. (Dickinson—*American Textbook of Obstetrics.*)

Diagnosis of Relaxed Floor

On inspection, it is found that, instead of a normal vaginal opening, the vaginal outlet is relaxed—that is, it is open and without tone or resistance (Fig. 488). The two index fingers introduced into the opening may be carried to the sides of the pubic arch with but little resistance. If now the patient be directed to bear down or strain, as in defecation, the sinking and protrusion of the parts become more marked and the relaxation of the floor is more apparent.

The relaxation is progressive, and leads to various complicating conditions. The cervix sinks into the pelvis and comes forward and the fundus uteri frequently goes backward into **retrodisplacement**. Also, the whole uterus lies too low in the pelvis, constituting **prolapse** of the uterus.

As the damaged pelvic floor and other supports of the uterus gradually stretch more, the uterus may sink so low that the cervix appears at the vaginal

opening. As the uterus sinks lower the vaginal opening enlarges and the vaginal walls roll outward, forming an anterior or posterior **colpocele.**

With the prolapsed posterior vaginal wall, sometimes the anterior wall of the rectum is found, forming a **rectocele** (Figs. 489 to 491). An appearance resembling rectocele may be produced by prolapse of a thickened vaginal wall. There is areolar hyperplasia and often considerable venous dilatation, giving quite a large projecting mass, but without displacement of the anterior rectal wall. Whether or not rectocele is really present is easily ascertained by rectal examination, to determine if the anterior rectal wall is pouched forward with the vaginal wall (Fig. 491, *A*). In some cases of rectocele a large pouch is formed and interferes much with emptying the rectum, it being necessary for the patient to push back the protruding rectocele to secure satisfactory bowel movement.
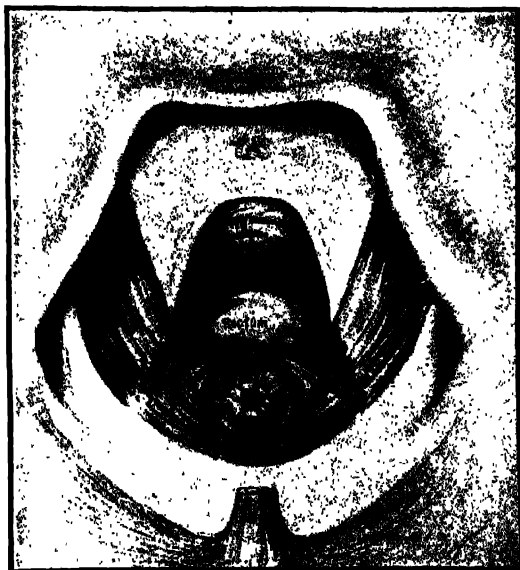
Fig. 487.   Fig. 488.

Fig. 487.—A deep laceration, extending up each vaginal sulcus and involving the pelvic sling on each side. (Gilliam—*Practical Gynecology*, F. A. Davis Company.)
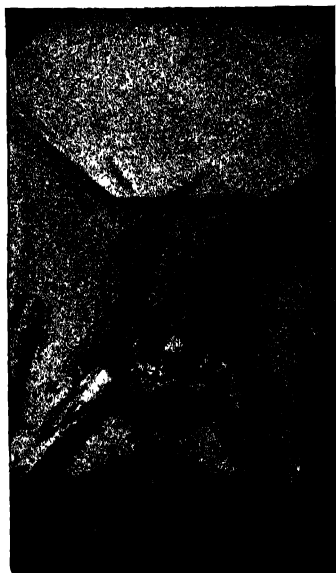
Fig. 488.—An old laceration. (Baldy—*American Textbook of Gynecology*.)

If the base of the bladder follows the prolapsing anterior vaginal wall, the condition is known as **cystocele** (Fig. 491, *B*). Sometimes a supposed cystocele is found to be only vaginal wall. In marked cystocele, a large pouch is formed at the floor of the bladder, in which residual urine remains and decomposes, causing much bladder irritation. It is sometimes necessary for the patient to push back the protruding cystocele before a satisfactory evacuation of the bladder can be secured. Straining at defecation or urination greatly aggravates the cystocele. In some cases both rectocele and cystocele are present (Figs. 489, 490).

The patient complains of dragging weight on the pelvis, of a feeling of weakness at the vaginal outlet, as though the parts were coming down and

out, and usually of backache across the sacral region. The symptoms come principally when the patient has been on her feet some time.

When the vaginal entrance is relaxed, air can enter the vagina, and it is sometimes expelled with more or less noise, which is very annoying to the patient. This phenomenon is known as "flatus vaginalis." It is merely a symptom of relaxed vaginal orifice. It was formerly described under the queer title of "garrulity of the vulva."
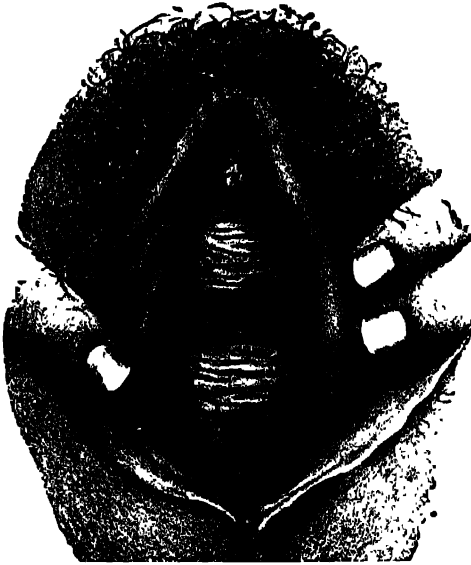
Fig. 489.
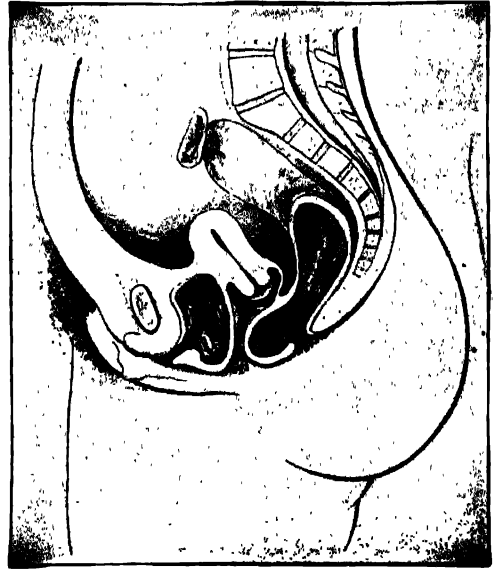
Fig. 490.

Fig. 489.—Cystocele and rectocele of moderate extent. (Thomas and Munde—*Diseases of Women.*)

Fig. 490.—Cystocele and rectocele of moderate extent. Sectional view. (Thomas and Munde—*Diseases of Women.*)
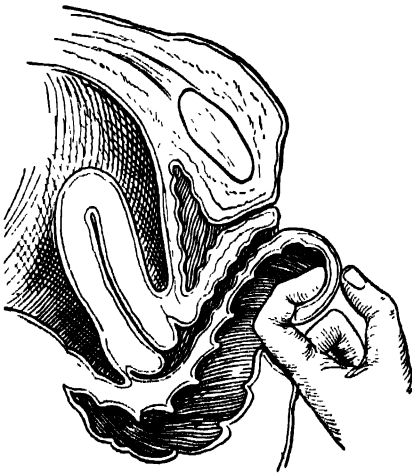
A.
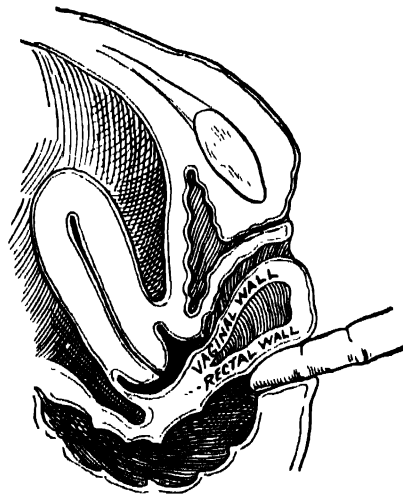
B.

Fig. 491.—Method of differentiating between rectocele and posterior colpocele. The index finger in the rectum determines whether or not the rectal wall follows the prolapsing vaginal wall. The hand should be gloved. *A*, rectocele; *B*, no rectocele. (Ashton—*Practice of Gynecology*, W. B. Saunders Company.)

Complications

In relaxation of the pelvic floor, there are frequently present vaginal discharge, painful menstruation, irregular menstruation, excessive menstruation, attacks of severe pelvic pain, dyspareunia, sterility, abortion, backache and dragging, and general poor health. These symptoms, however, are due principally to **associated diseases**, some of which may be traced to the laceration. The diseases frequently associated with relaxation of the pelvic floor are chronic cervicitis, subinvolution of uterus, endometrial hyperplasia, retrodisplacement of uterus, prolapsus uteri, parametritis, chronic salpingo-oophoritis.

All lesions present should be found and their severity determined before operative treatment is undertaken.

Treatment

Operative treatment is required when the relaxation is causing troublesome symptoms. But it is important to be certain that the troublesome symptoms are really due to the relaxation, and not to something else. Patients waiting for operation, or inoperable cases, may sometimes be made more comfortable by one of the pessaries used in retrodisplacement or in prolapse. Astringent douches, and recumbent rest several times daily, also help.

Object of the Operation.—The object of the operation is to restore a strong sling across the pelvic outlet to support the organs above. To restore the integrity of the pelvic floor, the following two things must be accomplished:

1. The musculofibrous pelvic sling must be shortened so that the slack is taken up.

2. The vaginal opening (the necessarily weak place in the pelvic floor) must be brought forward under the pubic arch and, consequently, out of the line of direct pressure from above.

Repairing the perineum is known as "perineorrhaphy." Suturing the vaginal wall is designated as "colporrhaphy."

Though the literal meaning of each of these terms is limited, they are frequently used to indicate the general suturing necessary in these cases. A more accurate and comprehensive designation for this operation is "repair of the pelvic floor." This operation comes under the general class known as "plastic operations," which includes also operation for cystocele and closure of fistulae and certain prolapse operations.

Methods of Shortening Sling.—The treatment of relaxation of the pelvic floor consists in taking up the slack, so that the pelvic sling is sufficiently shortened, and in restoring the perineal body, so as to carry the weak place in the pelvic floor (the vaginal opening) forward, out of the line of direct pressure.

The pelvic sling, the strong supporting part of the pelvic floor, consists of the levator ani muscles and the fascia above and below. This musculo-fibrous sling or diaphragm is the structure worked upon in repair of the pelvic floor. Shortening of this sling restores the pelvic-floor support, while if there is no shortening of the sling there is no lasting restoration of support.

Steps in Pelvic Floor Repair

Details of the operative steps for the ordinary relaxation operation are as follows:

1. Planning the Restored Vaginal Opening.—By careful examination of the vaginal entrance, the opening of the duct of the vulvovaginal gland may be identified on each side. Just below this on each side, at the point marked (x) in Fig. 492, the tissue should be caught firmly with the Allis forceps.

It is well to keep away from the vulvovaginal glands, if practicable, by keeping the incision below, or extending it inside if necessary to go higher. If, however, there are tender tags or infiltrated areas, they should be included in the operative incision.

Fig. 492.   Fig. 493.

Fig. 492.—The location of the incision for opening the pelvic floor. The authors prefer to place the incision well within the vaginal opening, as indicated by the heavy black line. The cross (x) on each side indicates the area to be caught by the forceps. Notice that the incision is well below the opening of the vulvovaginal gland on each side, which is indicated by the black dot. Allis forceps are most satisfactory for catching the sides.

Fig. 493.—Opening the pelvic floor by excising a strip of tissue.

(This series of operative drawings is from Crossen and Crossen—*Operative Gynecology.*)

2. Opening the Pelvic Floor.—The incision extends from one forceps to the other (Fig. 493). It should be placed well within the vagina as indicated by the dark line in Fig. 492. When so placed it is farther removed from the rectum, and hence from infection, and is in tissue less sensitive than the perineal skin. The floor may be conveniently opened by clipping off a line of tissue with the scissors, as shown in Fig. 493.

After the line of opening is made, the margin of the flap is bared by knife or scissors and then caught with a T-forceps (Fig. 494). With the gauze-covered finger, the loose connective tissue is quickly rolled off the vaginal flap (Figs. 495 to 497), as high as necessary to make good repair in that case and to take care of any rectocele that may be present.

Care must, of course, be exercised to avoid tearing into the rectum. The layer of veins constitutes the guide to safety. As long as the line of cleavage is kept between these veins and the vaginal wall, the rectum is safe. On the other hand, when the veins are permitted to remain on the vaginal flap, the line of cleavage is going too deeply and a hole may be torn into the rectum at any time.

3. Identification of the Musculofibrous Sling.—When the vaginal flap has been raised sufficiently, it is time for the exposure of the pelvic sling. This sling consists of the levator

ani muscle on each side and the overlying rectovesical fascia which forms its upper sheath. Both the fascia and the muscle should be included in the sutures, but it is not necessary to expose the muscle. Exposure and identification of the fascia enable the operator to include the fascia and the underlying muscle in the sutures.

The fascial surface of the pelvic sling is exposed by a combination of two simple maneuvers—(a) the vaginal flap is separated laterally well out to the pelvic wall and (b) the loose connective tissue over the sloping fascial plane is pushed off by a twisting motion
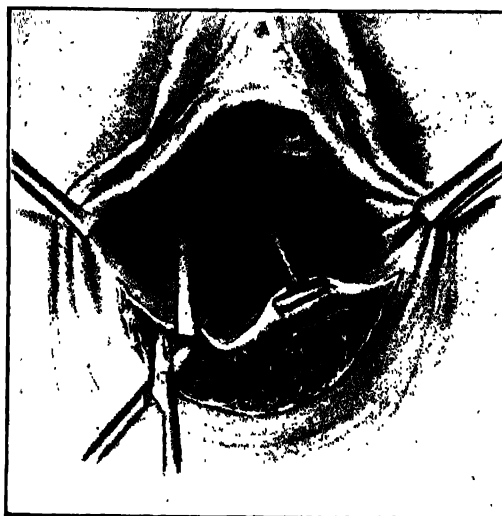
Fig. 494.   Fig. 495.

Fig. 494.—Freeing the vaginal flap on each side so it may be caught with the T-force, s. This may be quickly accomplished by thrusting in the closed scissors point against the vaginal wall and then opening the scissors. The maneuver has been carried out at the left side of the flap and the T-forceps applied, and the same maneuver is in progress on the right side.

Fig. 495.—Rolling off the underlying tissues from the vaginal wall with the gauze-covered finger. The motion is that of a push and a roll combined, and is made against the left forefinger which furnishes the counterpressure. As long as the dissection is kept close enough to the vaginal wall to push off the veins, there is no danger of injury to the rectum. When noticeable blood vessels are left on the wall, the dissection is progressing toward the rectum.

Fig. 496.   Fig. 497.

Fig. 496.—If preferred, the floor may be opened by incision and the edge of the vaginal flap freed with a knife.

Fig. 497.—Next the underlying tissues are pushed off with the gauze-covered finger from the vaginal wall which is held tightly stretched over the index finger of the left hand.

of the gauze-covered finger. It is important that the vaginal flap be separated entirely out to the lateral wall (Fig. 498) before trying to bare the fascia, otherwise the twisting finger will not be near enough to the fascia to expose it. The location of the gauze-covered finger and the direction of the pushing-twisting motion for clearing the loose connective tissue from the fascia are shown in Fig. 498.

When the surface of the fascia is exposed, it is identified by its smoothness in contrast to the loose connective tissue around it (Fig. 499). Also when picked up with an Allis forceps or small tenaculum forceps (Fig. 500), it presents the firm substance of fascia with underlying muscle, instead of loose connective tissue. The sling surface is exposed on both sides preparatory to suturing, as shown in Fig. 500.

Fig. 498.   Fig. 499.

Fig. 498. - The vaginal flap has been raised well out to the side wall, and the gauze-covered finger is in place for rolling off the loose connective tissue from the fascial surface of the musculofascial levator sling. The loose connective tissue is easily pushed off by a pushing-rolling motion of the finger in the direction indicated by the curved arrow.

Fig. 499.—The fascial surface of the sling exposed on the left side. Its smooth, firm surface distinguishes it from the surrounding loose connective tissue.

Fig. 500.   Fig. 501.

Fig. 500.—The surface of the musculofascial sling caught with forceps on the left side and raised for better identification and accurate passing of suture. If preferred, the sling may simply be picked up with the needle as the suture is passed, without demonstrating it with the forceps.

Fig. 501.—The first suture passed for subvaginal approximation of the sides of the musculofascial levator sling. It is well to make two rounds with this first suture, the second round including the loose tissue at the base of the vaginal flap, which tends to prevent later bleeding.

4. Approximating the Sides of the Sling.—The exposed sides of the sling are to be fastened securely together by sutures. It is well to pass the first suture around twice before tying, as indicated in Fig. 501. The upper round includes the connective tissue at the base of the vaginal flap. This is the tissue most likely to bleed, and it cannot be reached for suturing after the approximating suture is tied—hence, the advisability of including it in this first suture.

When this first suture is tied, it makes subvaginal approximation of the sides of the sling at the highest point, and narrows the vaginal lumen accordingly. It is well at this stage to *test the narrowing* to see whether it is too little or too much. The flap is dropped and three finger tips are introduced into the narrowed lumen, as shown in Fig. 502. At this stage of the operation the narrowed area should admit three finger tips easily. It is narrowed somewhat further by the additional deep suturing, but at the end of the operation the lumen should be large enough easily to admit two fingers deeply (Fig. 503). If on testing after the first suture is tied, the lumen is found still too loose, another bite is taken above the first. If the test shows the lumen too small, the first suture is removed and another introduced somewhat lower in the sling.
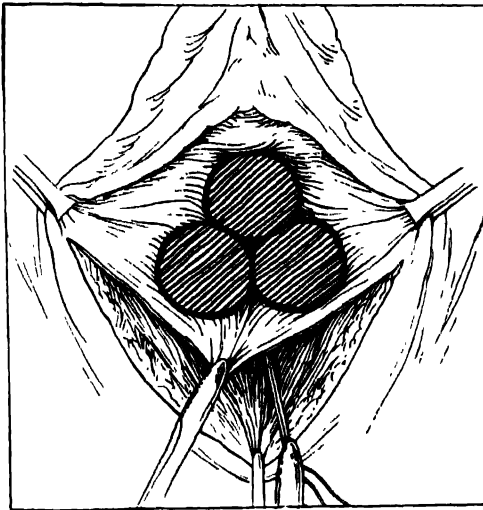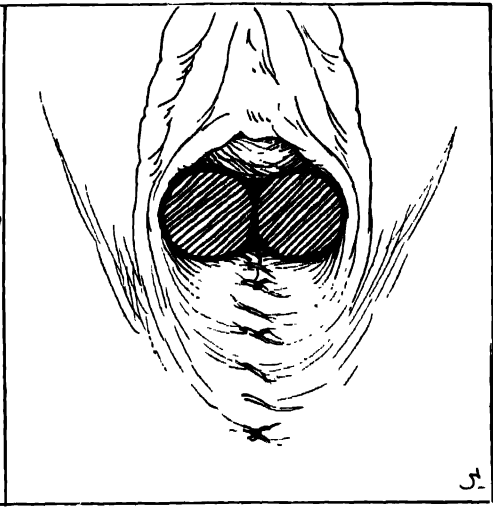
Fig. 502.   Fig. 503.

Fig. 502.—Testing the size of the opening immediately after tying the upper deep sling suture, to see whether the sling is repaired high enough. At this stage of the operation the opening should admit three fingers, as indicated.

Fig. 503.—Testing the size of the vaginal opening at the close of the operation, when it should admit two fingers easily. The supporting constriction should be well inside, as here indicated. Avoid constriction of the sensitive tissues at the mucocutaneous junction.

After the first approximating suture is tied and the result tested, the lower portions of the exposed sling surfaces are sutured together, as indicated in Figs. 504 and 505. The approximation may be made with a continuous suture or with interrupted sutures. The continuous suture saves time and reduces the number of buried knots. Having completed the sling suturing, the overlying connective tissue is approximated by the continuous suture going back (Fig. 505), to be tied finally at the first knot.

5. Closing the Opening in the Pelvic Floor.—The excess of vaginal wall is trimmed away, as shown in Fig. 506, and the vaginal wound is closed, as indicated in Fig. 507. In trimming away any excess of vaginal wall, be careful to leave some redundancy in order to avoid scar-tissue constriction which may be uncomfortable later. When the suture has been started in the upper angle of the vaginal wound, one bite should be taken into the deeper tissues in order to fasten down this redundant angle of vaginal wall. Unless this precaution is taken, this angle may later form a troublesome projection. The senior author recalls one case, operated on before the adoption of the fastening-down stitch, in which this projection was

so troublesome that it had to be excised later. Any bleeding tendency of the wound margins is easily controlled by half-locking the running suture, as shown in Fig. 507.

In suturing at the vaginal entrance make the opening wider there than at the supporting area inside, in order to avoid discomfort in coitus, as explained later.

For suture material 40-day catgut No. 1 is very satisfactory throughout, for both deep and superficial sutures. When using a continuous suture, it is well to lock it, as shown in Fig. 507, to control bleeding from the edges. Some may wish to use a subcuticular suture for the outside part of the wound.

Fig. 504.   Fig. 505.

Fig. 504.—The first sling suture has been tied, the resulting support-constriction tested (Fig. 502) and found satisfactory, and lower portions of the sling are being approximated by a few turns of the continuous suture. Some upward pull on the first suture and a counter pull below with finger or tissue forceps, causes the deep tissues to stand out for easy suturing.

Fig. 505.—The more superficial tissues are being approximated by the same running suture, as it is carried back to be tied to its end.
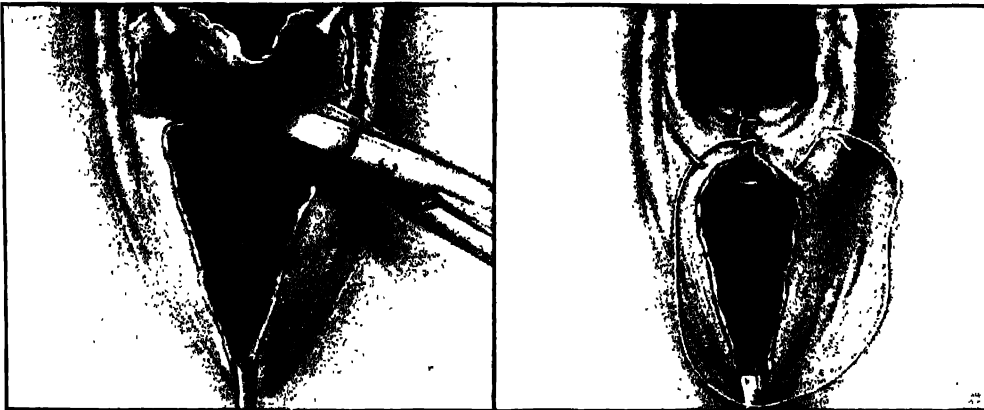
Fig. 506.   Fig. 507.

Fig. 506.—Trimming off the excess of vaginal wall where it is decidedly redundant. Some redundancy of the vaginal wall is beneficial in that it tends to prevent scar-tissue constriction which may be uncomfortable later. Consequently, any trimming should be done sparingly, leaving plenty of vaginal wall, so that there will be some loosenness after the suturing is completed.

Fig. 507.—Closing the wound. The half-locked suture checks bleeding from the wound margins. Avoid constriction at the vaginal opening that may cause discomfort later, as explained in the text.

6. *Avoid Constriction at Vaginal Entrance.*—Discomfort in coitus after pelvic floor repair is due usually to constriction at the vaginal entrance, rather than to the narrowing in the region of the supporting pelvic sling. Very exceptionally the discomfort is due to the development of a hypersensitive point in the repaired area of the sling, with or without undue

narrowing in that region. However, in most of the patients with this postoperative disturbance, the discomfort is due to narrowing of the vaginal entrance at the sensitive muco-cutaneous junction. In his anxiety to give good support, the operator is inclined to extend the maximum narrowing out to the sensitive skin margin, which extension is not necessary for support and is very likely to lead to the discomfort mentioned.

This postoperative disturbance may be avoided by special attention to certain details. As already explained the essential supporting structures of the repaired floor are some distance inside the vaginal entrance. From this point outward the opening should be left somewhat wider, giving a funnel effect with the narrow part inside away from the sensitive
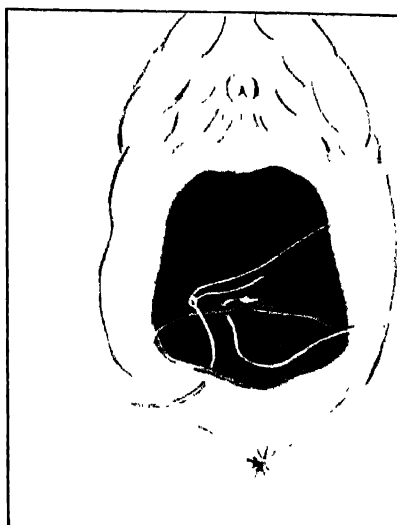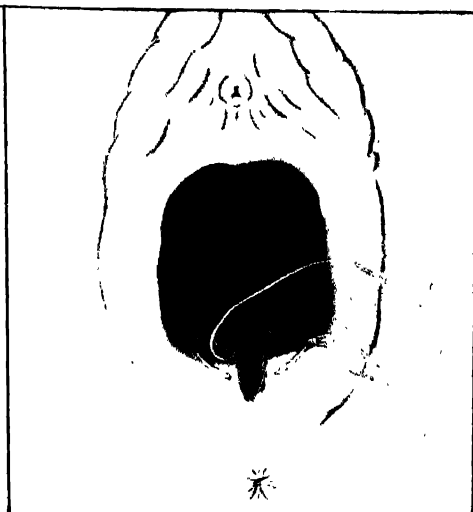
Fig. 508.   Fig. 509.

Fig. 508.—Closing each end of the wound horizontally in a case where this is necessary in order to avoid constriction at the vaginal entrance.

Fig. 509.—Closing the median portion of the wound vertically. As explained in the text, the relative amount of horizontal closure at each end (and the resulting amount remaining for vertical closure) is easily varied to meet the conditions in the individual case.
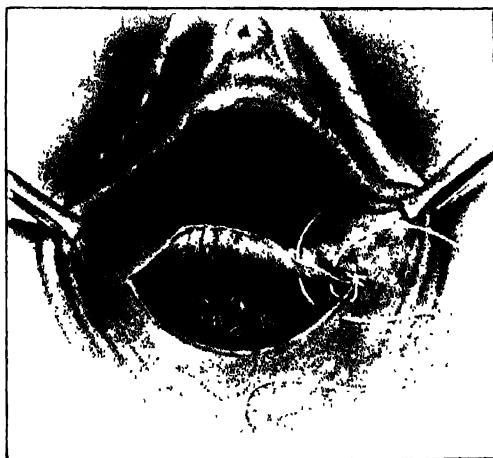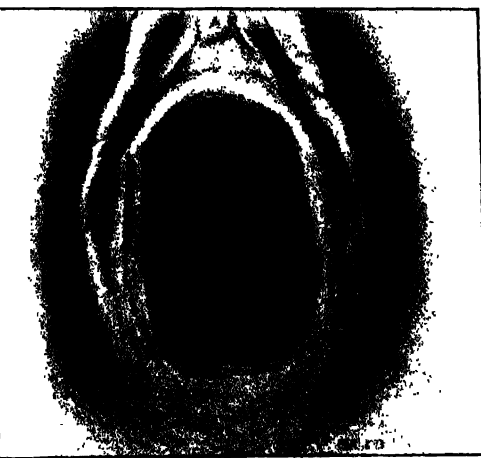
Fig. 510.   Fig. 511.

Fig. 510.—Closure of the wound after repair of moderate relaxation of pelvic floor without much redundancy of vaginal wall. There is no excision of vaginal wall. After the deep supporting tissues have been repaired as usual, the wound is simply closed horizontally, in the same direction in which it was made.

Fig. 511.—The horizontal closure completed. This preservation of a rather wide opening and redundancy of vaginal wall is especially important in nervous hypersensitive patients with a tendency to levator spasm.

skin margin. If this point be kept in mind in trimming away the excess of vaginal wall, the wound may be sutured in the usual way (Fig. 507). On the other hand, if too much of the vaginal wall has been trimmed away, it is then advisable to close as shown in Figs. 508 and 509, in order to avoid undue narrowing at the vaginal entrance. The horizontal closure at each end may be little or much, as needed to obviate constriction there. If slight, it is conveniently made by simply placing an interrupted suture at each end, and completing the vertical closure in the usual way. If a large horizontal closure is needed, continuous sutures may be used, as indicated in Figs. 508 and 509.

In certain exceptional cases it is advisable to avoid excision of any vaginal mucosa. After the supporting pelvic sling has been repaired, the raised vaginal flap is brought back into place and the wound is closed in the same direction in which it was made, as shown in Figs. 510 and 511. This maneuver is useful in hypersensitive persons with a tendency to levator spasm, especially when the pelvic floor relaxation is only moderate and without much redundancy of vaginal wall. It is indicated also in patients near the menopause without much vaginal wall redundancy. In patients in the menopause or after that period, there is a tendency after operation for the tissues about the opening to shrink gradually, rather than stretch as in earlier life, and this fact should be kept in mind in repairing the pelvic floor in patients of that age if subsequent coitus must be provided for.

RECTOCELE

A moderate rectocele (Fig. 512) is taken care of by the regular repair of the pelvic floor, which gives strong support over the whole area. A marked rectocele (Fig. 513), presents so much redundancy of the anterior rectal wall

Fig. 512.   Fig. 513.

Fig. 512.—Small rectocele.   (Hirst—*Diseases of Women.*)
Fig. 513.—Large rectocele.   (Hirst—*Diseases of Women.*)

that the pouch should be obliterated by infolding with some extra sutures. The vaginal flap is separated very high, in some cases two-thirds of the distance to the cervix uteri. Then, before the deep muscular sutures are passed, the

projecting pouch of rectal wall is obliterated by a row or two of fine chromic catgut suturing, as shown in Figs. 514 and 515. After that the regular pelvic floor repair is proceeded with, the next step being the suturing of the strong pelvic sling in front of the infolded rectal wall.

CYSTOCELE

Cystocele of the most severe type (Fig. 517) occurs in conjunction with prolapse of the uterus, and its correction constitutes one of the important features in operation for prolapse, with which subject it is considered. Cystocele of moderate degree not complicated by uterine prolapse or retrodisplacement does not require such extensive operation for correction, but it does require careful investigation to determine the exact type of lesion present in the particular case and an accurate operative procedure adapted exactly to the conditions found.

Fig. 514.   Fig. 515

Figs. 514 and 515.—Special sutures for rectocele. Fig. 514 shows method of placing the first row of sutures for turning in the redundant rectal wall. Fig. 515 shows the first row completed and the second row being passed.

The small or moderate cystocele (Fig. 516), which seems such a simple lesion and so easy to correct, is really a lesion of unusual interest. There are important hidden features which required a long time to work out, and which are still unappreciated by many operators. The troublesome symptoms of this type of cystocele are largely those of mild bladder irritation—frequency, urgency, recurring desire to urinate, and imperfect control. In many cases these symptoms persist after operative correction of the vaginal cystocele. It was this persistence of symptoms which led to the prolonged study that brought out the following facts:

1. There are two kinds of cystocele—the high one which occurs above the upper margin of the vesical trigone, and on vaginal examination is found immediately in front of the cervix uteri, and the low one which involves the vesical trigone and sphincter area and urethra and is found at the vaginal entrance. The first (posterior cystocele) is

a simple stretching of the bladder wall and adjacent supporting tissues, and is taken care of by the usual infolding operation with elevation of the bladder to its normal position on the uterus.

2. The anterior cystocele, involving the trigone and urethra, represents serious damage to the bladder control mechanism, and its cure requires study of this mechanism, determination of the exact damage in the particular case and adaptation of measures to restore normal functioning. The projecting pouch at the vaginal entrance may be obliterated by suturing and still the patient continue to have the annoying bladder symptoms, for the relief of which she went through the operation.

3. Study of these cases has shown that from the stretching and pressure of the tissues in labor, between the advancing head and the pubic arch, there has been damage to the trigone longitudinal muscle and sphincter and urethra, which structures must cooperate in the normal mechanism of bladder evacuation and urine control. The trigone muscle, which passes from the trigone forward through the internal sphincter and is attached along in the urethra, is an important factor in normal evacuation of the bladder, for contraction of
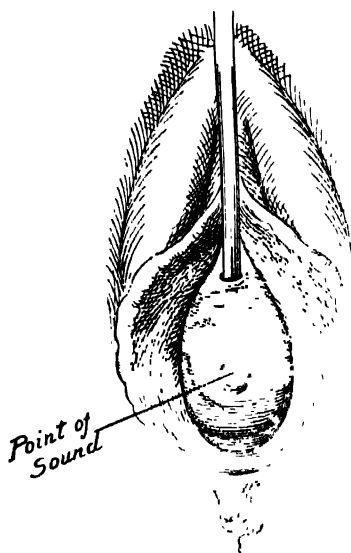
Fig. 516.   Fig. 517.

Fig. 516.—A small cystocele   (Ashton—*Practice of Gynecology.*)
Fig. 517.—A large cystocele.   (Ashton—*Practice of Gynecology.*)
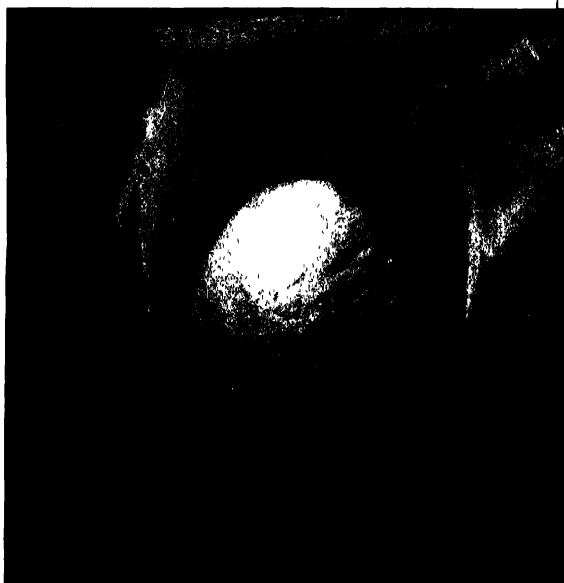
this longitudinal muscle opens the sphincter and at the same time depresses its lower margin so that all urine can escape. This muscle is torn across more or less in these cases so that the lower margin of the sphincter is not depressed, and residual urine remains. The irritation from the residual urine and other factors causes strong contraction of the sphincter, which draws it up farther and makes more pouching and more residual urine. Thus there is established a vicious circle which makes the lesion a progressive one. That is the reason why troublesome cystocele may not appear till some years after the childbirth which caused the primary damage, and also the reason why the partial immediate relief following simple obliteration of the vaginal pouching gives way later to return of the old bladder symptoms.

4. In addition to the damage to the trigone muscle and vesical area, the urethra also suffers a functional disorganization. The stretching, with pinching of the structures between the child's head and the pubic arch, damages the urethra and its fascial sheaths so that they sag and form a urethrocele. The meatus, being out of the line of direct compression, retains its high position. Thus, instead of a fairly straight urethra with strong walls, the patient has a curved, wide, sagging urethra. The dragging on the high fixed

narrow meatus tends to narrow it still further toward stricture. This urethral distortion also is progressive, and continues so after simple operation for obliteration of the vaginal pouch.

5. The cure of this condition necessitates, first, its recognition through competent cystoscopic investigation which determines the particular type and combination of lesions in that case and, second, the employment of special suturing which restores the functional continuity of the trigone muscle, obliterates the urethrocele and straightens the sagging and bowed urethra. The details of this operative work are described and illustrated in our operative volume.

6. Three other points of interest are: a. For permanent relief, it is important to repair also the pelvic floor and any rectocele, so as to back up the repaired anterior plane by good support in the posterior plane. b. Cystoscopic investigation of the trigone muscle area and also of the urethra is advisable in all cystocele cases before operation, that the exact conditions may be determined and the operation planned accordingly. c. Trigone muscle injury may be present without any evident vaginal cystocele, and hence there should be cystoscopic examination for this lesion in any case of persistent bladder discomfort even though there is no outside evidence of childbirth damage.

7. This troublesome lesion, which is progressive and hence gives increasing disturbance through the years, may be prevented by well-timed episiotomy, which permits delivery of the head and shoulders without the serious overstretching of the tissues at the base and neck of the bladder and along the urethra.

Partial Incontinence of Urine

Some patients complain of inability to control the urine when coughing, laughing, sneezing, etc. Others state they must empty the bladder promptly or there will be leakage. In case of inability to control the urine, resulting in some escape at times, the first thing is to determine whether the escape is due largely to irritation, causing premature expulsive contraction, or altogether to weakness of the vesical sphincter control.

In the cases due largely to mild cystitis or other irritation, the leakage is preceded by a desire to urinate which must be responded to promptly or leakage will follow. In such a case, cystoscopic investigation and treatment will often restore control by eliminating the mild cystitis or pyelitis.

Endocrines, male as well as female, have been found to influence bladder and ureteral function. Schultz and Anderson report 50 cases of enuresis in children treated with male hormone, with 54 per cent cured.

LACERATION OF SPHINCTER ANI MUSCLE

If the laceration of the pelvic outlet has extended through the sphincter ani muscle (Fig. 518), there will be incontinence of feces and intestinal gases, making the patient miserable and excluding her from society. When completely torn, the sphincter ani retracts—sometimes to such an extent that it scarcely reaches halfway around the rectal opening. It may be felt as a thick cord at the posterior part of opening. A slight dimple, or retraction of tissue, frequently marks the location of each end (Figs. 519 to 521). A small area of the rectal mucous membrane may be visible as a red inflamed-looking spot, marking the situation of the anus (Figs. 520, 521).

If the sphincter muscle is not completely torn, a few fibers remaining intact, the patient may be able, even from the first, to retain solid feces—that

Fig. 518.

Fig. 519.

Fig. 518.—A laceration extending directly through the sphincter ani muscle and other structures between the vagina and rectum. The levator ani muscles are not involved. (Gilliam —*Practical Gynecology*.)
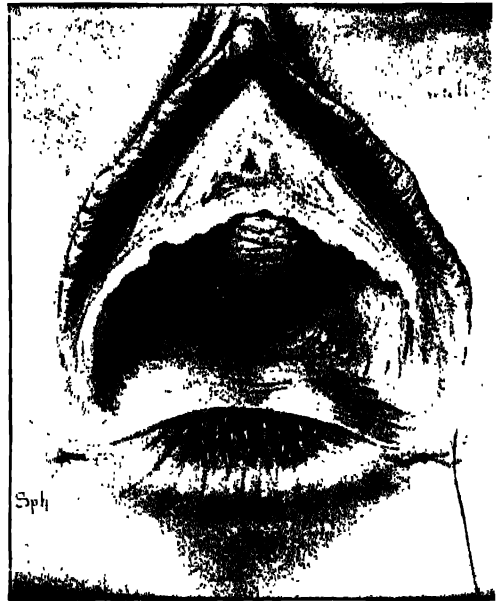
Fig. 519.—Representation of the conditions present in an old laceration through the sphincter ani. Notice the wide separation of the sphincter ends and also the exposed rectal mucosa. Each end of the torn sphincter ani muscle is indicated by a slight dimple in the skin. (Kelly—*Operative Gynecology*.)

Fig. 520.

Fig. 521.

Fig. 520.—Complete laceration of the perineum. The sphincter ani muscle has been torn and the ends are separated. The small dark area is an exposed portion of the red mucosa of the rectum. (Hirst—*Diseases of Women*.)
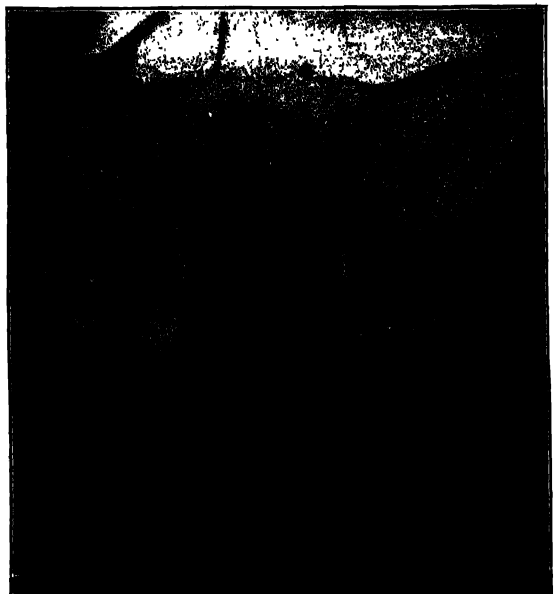
Fig. 521.—Another case of laceration through the perineum into the rectum. Notice the separation of the sphincter ends and also the patch of rectal mucosa. (Hirst—*Diseases of Women*.)

is, there is only partial incontinence. In these cases of partial rupture of the sphincter, and also in cases of complete rupture in which the muscle was paralyzed by the stretching before rupture and the ends of the muscles or tissues close to the muscle lay in contact and became partially united, the patient has control of the bowels except when diarrhea is present. In some cases the patient has control over feces, both solid and liquid, but there is incontinence of gases.

Fig. 522.—Laceration through the sphincter ani muscle. In the course of months and years the torn muscle tends to straighten out, causing the torn ends to become widely separated, as here shown. Also, the upper angle or point of the rectal tear is gradually drawn downward.

Fig. 523.—Stretching the atrophic and contracted sphincter ani muscle, preparatory to repair.

A laceration through the sphincter ani muscle and rectovaginal septum does not necessarily mean that there has been great damage to the pelvic sling. The principal part of the sling passes back of the rectum, not between it and the vagina.

If the rectal tear is accompanied by deep lacerations at the sides of the vagina, involving the levator ani muscles, then there will be marked loss of support in the pelvic floor and consequent relaxation of the vaginal outlet. Such accompanying deep lateral lacerations do frequently occur with the result mentioned. But in some cases, the tear in the median line into the rectum seems to have been the only serious damage. In such a case, the incontinence of feces is the only troublesome symptom, there being no evidence of want of support for the pelvic organs.
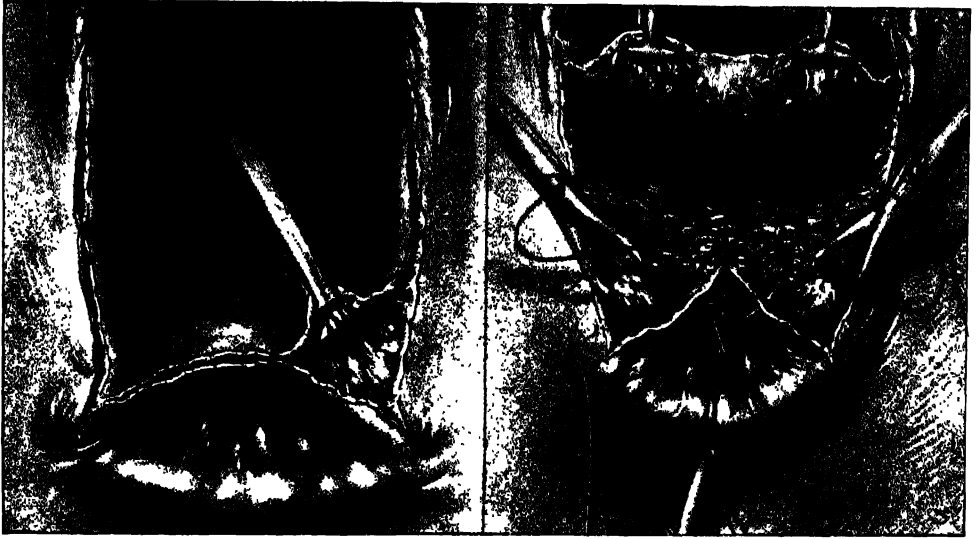
Fig. 524.   Fig. 525.

Figs. 524 and 525.—Rectal suture method of repairing complete laceration. Fig. 524 shows line of incision. Fig. 525 shows method of suturing rectal wall.
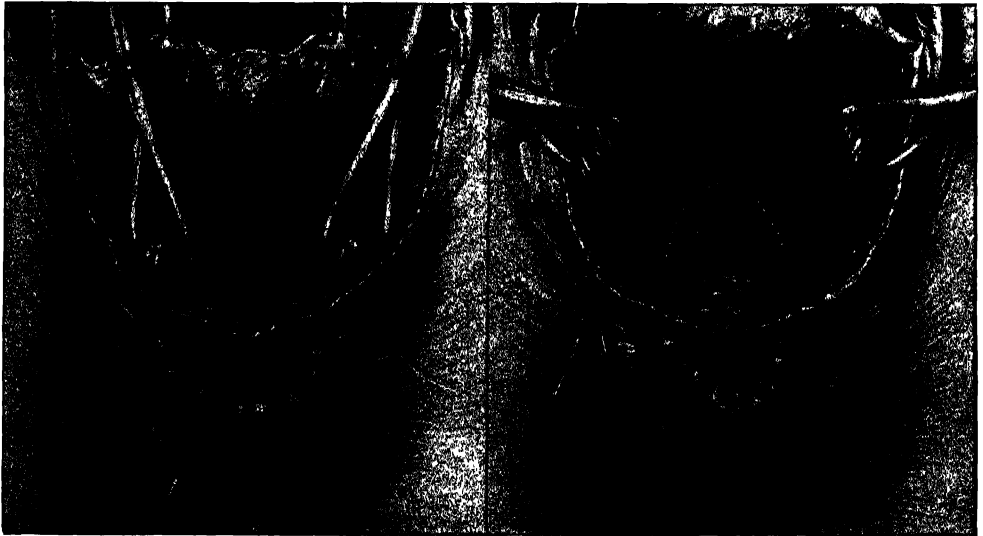
Fig. 526.   Fig. 527.

Figs. 526 and 527.—Rectal suture method of repairing complete laceration. Fig. 525 shows rectal suture completed, and sphincter ends isolated ready for suturing. Fig. 527 shows sphincter ends sutured, and the reenforcing silkworm-gut sutures passed.

Fig. 528.   Fig. 529.

Fig. 528.—Closure of rectal wall by a continuous suture, with a small curved needle on each end. The suture begins in the muscle *above* the apex of the tear and ends in the anal skin superficial to the sphincter ani.

Fig. 529.—The other end of the suture approximates the perirectal tissues over the first line of suture. Using a continuous suture the rectal wound is thus closed in two layers. No suture penetrates the rectal wall, and there are no knots buried or anywhere in contact with the rectum, the two ends of this suture being tied outside and constituting the lowermost perineal suture outside the skin (Royston —*Am. J. Obst. and Gynec.*)

Fig. 530.   Fig. 531.

Fig. 530.—The rectal wound has been closed in two layers with ends shown not yet tied. The sphincter ani is now united by a deep suture through the inner third.

Fig. 531.—Two sutures, preferably mattress or simple interrupted sutures, are carried through the outer third of the sphincter ani and now approximate the margins of the latter. The knots are placed on opposite sides away from the line of union. Note the free ends of the sutures used to close the rectal wound. (Royston—*Am. J. Obst. and Gynec.*)

This essential difference between median and lateral lacerations explains why it is that some cases of complete perineal laceration with incontinence are not accompanied with the prolapse of the uterus and vaginal walls, so frequently seen in incomplete perineal lacerations. On the old theory that the perineum (perineal body) was the important supporting structure at the pelvic outlet, this class of cases was inexplicable. Since the facts in regard to the anatomy and function of the component parts of the pelvic floor have become known, these cases are easily explained.

Steps in Repair of Lacerated Sphincter Ani

When the tear has extended into the rectum (laceration through the sphincter, "third degree tear"), a more thorough preoperative preparation of the intestinal tract is required, for it is advisable that there be no bowel

Fig. 532.—Flap operation for torn sphincter ani. The incision for opening the pelvic floor. The angle of the incision on each side should be kept well above the depression marking the end of the esphincter.

movement for a week to ten days after operation. The patient should be on restricted diet, principally liquids, for two or three days before operation. She is to be given a moderate dose of castor oil one or two days before, an enema the evening before, and colonic flushing the morning of the operation.

Repair of the torn and incontinent sphincter muscle and rectal wall injury is a difficult operation requiring familiarity with surgical work in this region and particular care. Even then there is failure at times, and every attempt increases the difficulties of the next attempt. The details of the operation for this condition are given in the operative volume, but the principles of the correction are shown in the accompanying illustrations.

The first step, common to all three types of operative correction, is stretching of the contracted sphincter muscle, as shown in Figs. 522 and 523, to lengthen it so that it can encircle the rectal exit.

The regular open method of repair with suturing through rectal mucosa is shown in Figs. 524 to 527. The pelvic sling suturing and other steps of pelvic floor suturing are completed after this special work.

The open method of repair with submucosal suturing is shown in Figs. 528 to 531.

The flap method of repair is shown in Figs. 532 to 534. After the suturing of the sphincter muscle and the pelvic floor repair, the flap is brought up and sutured in place. This plan eliminates the rectal mucosal wound and leakage through it. Particular care, however, must be exercised to avoid sloughing of the flap, and consequent opening of the wound to rectal contents.

Miller and Brown report a series of cases in which incision of the repaired sphincter muscle was employed to prevent spasm and tension which might interfere with healing. Their technique is shown in Fig. 535.
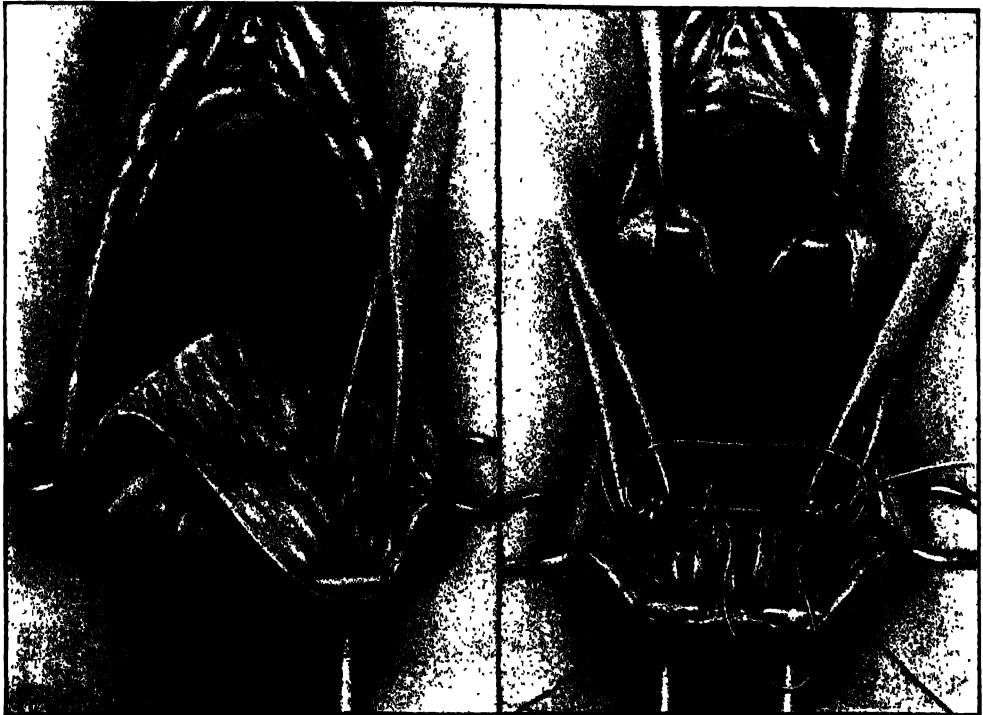
Fig. 533.   Fig. 534.

Fig. 533.—Turning down the flap. Care should be taken to avoid separating the flap too near to the rectovaginal scar, as that might interfere with its blood supply and cause slough-ing. Button-holing of the flap also is to be avoided—a difficult task at times. If the flap is button-holed in a location to interfere with its integrity, it is preferably excised and the regular repair previously described carried out.

Fig. 534.—Identifying and suturing the sphincter ends. The course of the silkworm-gut suture is also shown.

Postoperative Care

The details of the usual care after vaginal operation are given in Chapter XIX. The items of special care after repair of laceration into the rectum, relate to protection of the healing area in the rectum from irritating material there and from strain or stretching that may tear apart the newly healed sphincter

muscle. Both of these objects are best attained by keeping the rectum empty for ten days to two weeks. This means no bowel movement during that time, and requires special diet and codeine or other sedative to avoid peristalsis.

Protection of the outside wound is probably best secured in many cases by leaving it alone, free from irritation by douching, sponging, dressing, etc. If there is already an irritating vaginal discharge, pitcher douching without handling and perhaps vaginal douching also may be advisable, if they make the patient more comfortable. There is a good deal to be said pro and con in regard to douches and dressings in postoperative care; and as the matter
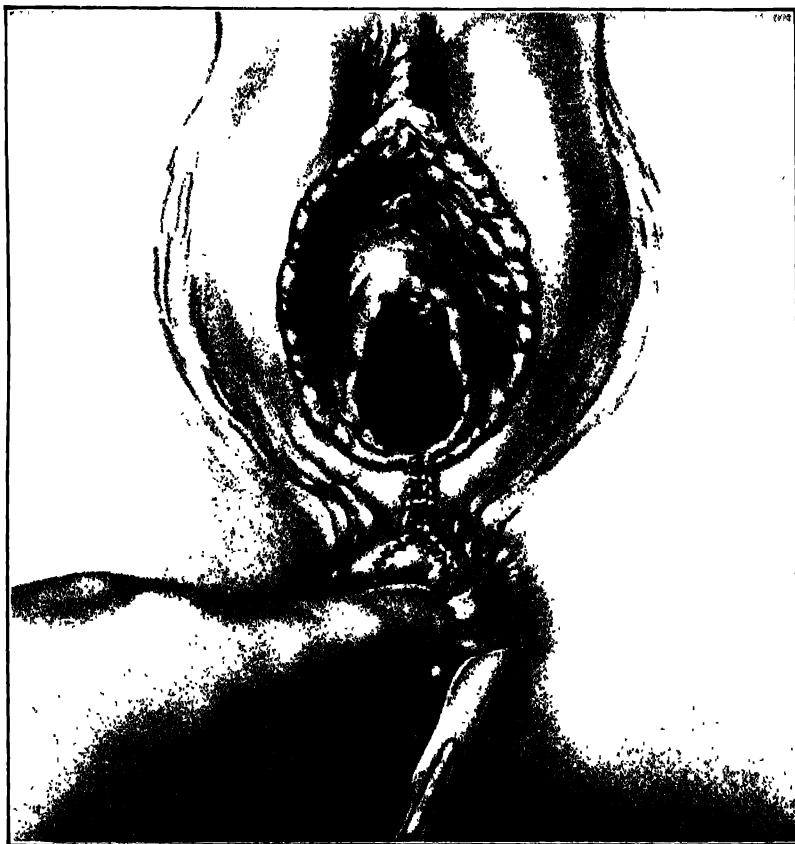
Fig. 535.—Incision of the sphincter muscle at the end of the operation. This may be done earlier if the muscle-ends cannot be brought together readily. Called "paradoxical" operation for repair of the sphincter. (Miller and Brown—*Am. J. Obst. & Gynec.*)

is still in the balance and cases differ so much, the comfort of the patient may usually be taken as the guiding factor. In general, the less any clean wound is disturbed by handling and dressing, the better it heals. On the other hand, an irritating vaginal discharge remaining and decomposing on a wound is more likely to cause discomfort and infection than if removed at suitable intervals by a nonirritating douche.

When the time comes for bowel movement, a soft stool is to be secured without straining and if possible without disturbing the healed rectum by enema or rectal tube. In case an enema should be found necessary to supplement the laxative, an enema of an ounce of oil should be carefully injected

through a small catheter and allowed to remain until a bowel movement is accomplished without straining. This may be supplemented later, if necessary, by a small enema of water, not more than four ounces, and given slowly to avoid distention.

RECTOVAGINAL FISTULA

From injuries in labor or from destructive ulceration or from other causes, fistulous openings may form, extending in various directions. The different varieties of genital fistulae, with the name given to each, are shown in Fig. 536.

A **Rectovaginal Fistula** is an opening from the rectum into the vagina. The size of the fistula may vary from a small tortuous tract, admitting only a small probe and permitting only gas or fluid to escape, to a large opening, involving a large part of the rectovaginal septum, through which pass practically all the rectal contents.

Fig. 536.—Fistulae of the genital tract. *1.* Urethrovaginal fistula. *2.* Vesicovaginal fistula. *3.* Rectovaginal fistula. *4.* Vesicouterine fistula. *5.* Ureterovaginal fistula. *6.* Intestinovaginal fistula. (Gilliam—*Practical Gynecology.*)

Etiology and Pathology

The following are the causes of rectovaginal fistulae:

1. *Injuries in Labor.*—In rare cases a hole may be torn through the rectovaginal septum, resulting directly in a fistula. Usually, however, a fistula resulting from labor is due to a complete laceration of the perineum, which is repaired at once or later, but fails to heal entirely. The lower part of the approximated surfaces unites, but a small part of the upper angle fails to heal, and the result is a fistula extending from the rectum into the vagina.

2. *Chronic Ulceration* of the posterior vaginal wall, which may be chancroidal or syphilitic or tuberculous. It usually affects the lower part of the vagina.

3. *Stricture of the Rectum,* with dilatation and ulceration of the rectal wall above it.

4. *Malignant Disease* of the rectovaginal septum is usually secondary to cancer of the cervix uteri or cancer of the rectum.

5. *Operation.*—A pelvic abscess which has ruptured into the rectum will, if opened into from the vagina, give a rectovaginal fistula. Again, in stricture of the rectum, there may be dilatation and ulceration of the rectal wall above the stricture with perirectal inflammation and an abscess. Such an abscess, if opened into from the vagina, will give a rectovaginal fistula. Again, the rectal wall may be injured directly in various operations.

Diagnosis

The diagnostic symptoms of rectovaginal fistula are the escape of some of the rectal contents into the vagina, and the vaginal irritation caused thereby. The amount and character of the leakage from the rectum vary much in different cases. In the smallest fistulae only gas, with occasionally some liquid, passes. With the opening a little larger, there may be free leakage only when the bowels are loose and the contents fluid. In still other cases, nearly all the rectal contents, whether fluid or solid, pass through the fistulous opening.

Digital examination reveals a rough place in the posterior vaginal wall. On inspection, if the opening should be large, it may be seen; but if small, only a rough place with a small slit is visible. Very often a red papule marks the vaginal opening of the fistula. Exploration of the opening with a probe, with a finger of the other hand in the rectum, shows that the sinus communicates with the rectum. In a doubtful case in which the opening cannot be found or in which a probe cannot be introduced, the fact that there is a rectovaginal fistula may be established and its location determined by injecting colored water (methylene blue, ⅕ per cent solution) into the rectum and watching for its appearance on the posterior vaginal wall. If there is syphilitic or chancroidal or tuberculous ulceration, or if there is a stricture of the rectum or malignant disease, the evidences of the complicating disease will be present, in addition to the evidences of fistula.

Treatment

In the rectovaginal fistula following labor, that is, where part of the repaired rectovaginal septum failed to heal, no secondary operation should be undertaken for the closure of the fistula for six or eight weeks after labor. The fistula may close spontaneously within a few weeks. Again, an operation in the genital tract during the puerperium increases the chances of puerperal sepsis and later, when she has recovered from the debilitating effects of parturition, the patient will be in much better condition generally for the operation. Locally, also, the tissues have returned to their normal condition, and complete primary union is much more certain to follow the operation. For some time following labor the uterine discharge would tend to interfere with healing, and the tissues are so friable that the sutures are much more liable to cut through.

Palliative Treatment.—In the meantime, the vagina must be kept clean by antiseptic vaginal douches, once, twice, or three times daily, as indicated by the amount of leakage through the opening. If the opening is very small, stimulation by touching it occasionally with silver nitrate stick, or with carbolic acid, will sometimes cause the fistula to close. If the fistula persists after thorough recovery from the parturition, it may be closed by operation.

Operative Treatment.--The preparation of the patient, operator, instruments and dressings are the same as for complete laceration of the pelvic floor. This apparently simple operation is frequently a disappointing one, on account of infection from the rectum preventing healing, even in spite of the care and skill of those specially trained and experienced in this operative field. A point to be kept in mind is that every failure adds to the difficulty of subsequent repair, hence operation should not be undertaken unless one is prepared to deal with the condition in a thorough way.

Other Fecal Fistulae

Occasionally there occur other varieties of fecal fistula, opening into the genital tract. There may be an opening into the vagina from the sigmoid flexure or from the colon or from the small intestine. There may be an opening into the uterus from the sigmoid or from the colon or from the small intestine.

VESICOVAGINAL FISTULA

There may be an opening between the genital tract and the urinary tract at one of several situations (Fig. 536). The location is indicated by the name as follows:

Urethrovaginal Fistula—Between Urethra and Vagina.
Vesicovaginal Fistula—Between Bladder and Vagina.
Ureterovaginal Fistula—Between Ureter and Vagina.
Vesicouterine Fistula—Between Bladder and Uterus.
Ureterouterine Fistula—Between Ureter and Uterus.

All of these fistulae are rare, the most common being the vesicovaginal. A **vesicovaginal** fistula is an opening from the bladder into the vagina. The size of the fistula may vary from a small opening, permitting only slight leakage, to a large opening through which all the urine passes.

Etiology

The following are the causes of the vesicovaginal fistula:

1. *Injuries in Labor.*--In prolonged labor where the lower portion of the bladder is caught and held for several hours between the head and the pubic bone, sloughing may follow. Part of the base of the bladder and the anterior vaginal wall are bruised, the circulation is more or less cut off, the parts become gangrenous and after a few days the slough separates, leaving a vesicovaginal opening through which the urine passes. Such injuries are rare in recent years on account of the great improvement in obstetric teaching and practice. Now, the head is not permitted to remain for several hours in such a position that it makes serious pressure on the bladder. If the head does not advance satisfactorily within a reasonable time after the rupture of the membranes, the child is delivered by forceps or otherwise.

A still rarer form of damage to the bladder in labor is that in which the bladder is torn directly, either by the manipulations incident to a version or by the forceps. In that case the dribbling of urine is noticed immediately, or within a few hours after labor, whereas if the fistula is due to sloughing, there is no escape of urine until the separation of the slough, which requires several days.

2. *Chronic Ulceration* of the anterior vaginal wall or the base of the bladder. The ulceration may be chancroidal, syphilitic, or tuberculous.

3. *Malignant Disease* of the vesicovaginal septum is usually secondary to cancer of the cervix uteri.

4. *Operations.*—One of the methods of treating severe chronic cystitis is to make an opening from the vagina into the base of the bladder, so as to give constant drainage of the latter. Such an opening usually closes spontaneously a short time after the drainage tube is removed. It may, however, fail to close promptly after its usefulness is ended, and in that case becomes a vesicovaginal fistula, requiring operation. Another cause is accidental injury of the bladder during hysterectomy.

Diagnosis

The patient complains of urine coming from the vagina and of much vaginal irritation. In some cases the patient complains simply that she cannot control the urine.

Digital examination reveals a rough place on the anterior vaginal wall. If the opening is large, it may be distinctly made out with the finger. If the opening is small, only a slight elevation or depression or rough place may be felt. Upon inspection, if the opening is large, it may be seen, but if it is small, only a red papule marks the site. If the opening be watched a few minutes, urine may be seen escaping from it. Cystoscopic investigation shows the location and size of the opening in the bladder. If the diagnosis is doubtful, sterile methylene blue solution may be injected into the bladder and its appearance watched for at the supposed vaginal opening of the fistula. There is another condition which must be carefully differentiated from vesicovaginal fistula, namely, ureterovaginal fistula.

When the vesicovaginal opening is large, the fact that it communicates with the bladder is apparent, and the margins of the opening and the adjacent surfaces of the vaginal mucosa and vesical mucosa are frequently encrusted with the phosphates from the decomposed urine. In one of our cases there was a large phosphate stone nearly filling the contracted bladder and projecting through the large vesicovaginal opening into the vagina.

The irritation caused by the decomposition of urine in the vagina is very great, and the constant odor of decomposing urine combined with the constant leakage of fluid, soaking pads and clothing, makes the patient miserable.

Treatment

If the fistula is due to malignant disease, no attempt should be made to close it unless the malignant infiltration is so situated that it can be completely extirpated. In the inoperable cases, local cleanliness and local sedatives are indicated.

If the fistula has resulted from sloughing after labor or from operation, it is best to postpone the operation for repair until the patient has fully recovered, and the tissues have become strong enough to hold the sutures well. During the time the patient is waiting, palliative treatment will be necessary.

Palliative Treatment consists in keeping the parts clean and in receiving and disposing of the urine so that it does not come in contact with the clothing. To accomplish the first object, a urinary antiseptic such as urotropin should be

given internally. Also a vaginal douche of borax (a tablespoonful to a quart of water) or a weak carbolic douche (½ per cent) should be given two or three times daily, and the external genitals should be washed frequently with a carbolic wash. If there is much vulvar irritation, the measures mentioned under Acute Vulvitis may be employed. Some relief may be given by coating all surfaces, with which the urine comes in contact, twice daily with benzoated zinc-oxide ointment.

For catching the urine and protecting the clothing from constant contamination, one of the urinals found in the instrument stores may be helpful. Many types of apparatus have been devised to relieve the discomfort of these patients. Figs. 537 and 538 show a special bed pad which has proved practical and useful in this matter. The quotation is from the description by Murphy.

Fenestration showing towels beneath   Rubber envelope

Sponge rubber pad

3 bath towels
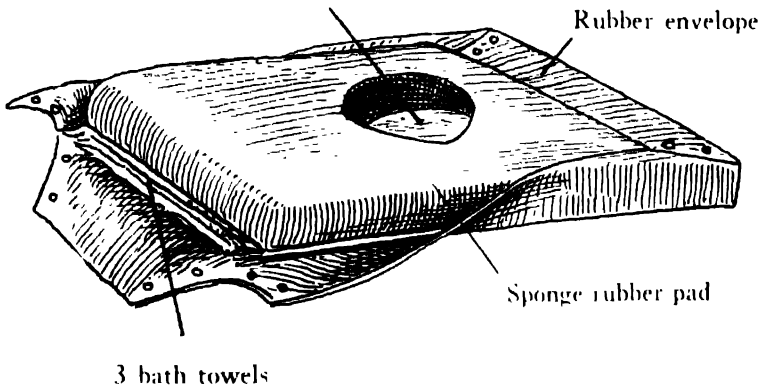
Fig. 537.

Triangular cotton pad covers

Towels

Sponge rubber pad

Rubber envelope
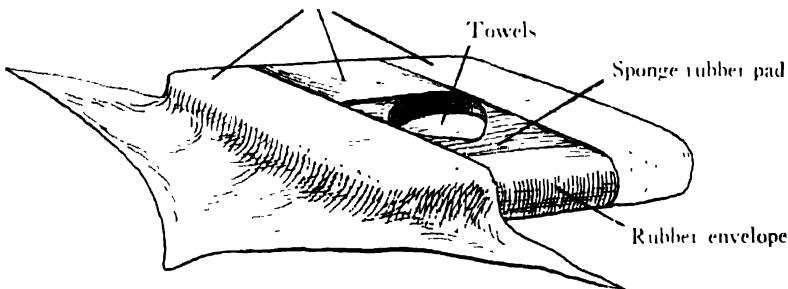
Fig. 538.

Figs. 537 and 538.—A special pad for keeping the patient dry in bed in cases of vesicovaginal fistula. (Murphy—*Am. J. Obst. & Gynec.*)

Patients having inoperable, vesicovaginal fistulas suffer much distress from being constantly wet. At night, the necessity of getting out of bed, in order to remove wet clothing, interrupts their sleep to such an extent that a full measure of rest is impossible. Furthermore, the heat of the body hastens the decomposition of the urine, which is absorbed by the clothing, with the production of the well-known disagreeable odor, distasteful to patient and family alike. The device shown eliminates the above difficulties, for by its use, the patient is able to remain dry, and at the same time experiences no odor of decomposing urine.

The apparatus consists of two parts, a rubber pad and an envelope. The pad is made of sponge rubber and measures 18 by 24 by 3 inches. It possesses a centrally placed fenestration, measuring approximately 8 by 8 inches, which is somewhat the shape of a

toilet seat. The sponge rubber is entirely covered by having cemented to its surface a sheet of smooth, soft texture rubber.

The envelope fits the pad, for which purpose its corners are mitered and supplied with metal snap fasteners; it is made of the same fine quality rubber sheeting as is cemented to the pad. Additional equipment includes bath towels to absorb the urine, and three triangular pieces of cotton cloth, to protect the patient's body from the rubber.

The bed is prepared for sleeping in the usual manner. Several bath towels are placed in the bottom of the rubber envelope, and upon these is laid the rubber pad. The corners of the envelope are then fastened. Next, the pad and envelope are placed across the bed with the tapered end of the fenestration toward the foot. The pad is covered by using the three triangular pieces of cotton cloth as shown in Fig. 538. The two pieces covering the ends of the pad are applied last, since they are the ones which might possibly get wet. Either of these end pieces can be removed independently, without the patient being required to get out of bed to do so. In actual practice, however, the wetting of these covers is very rare.
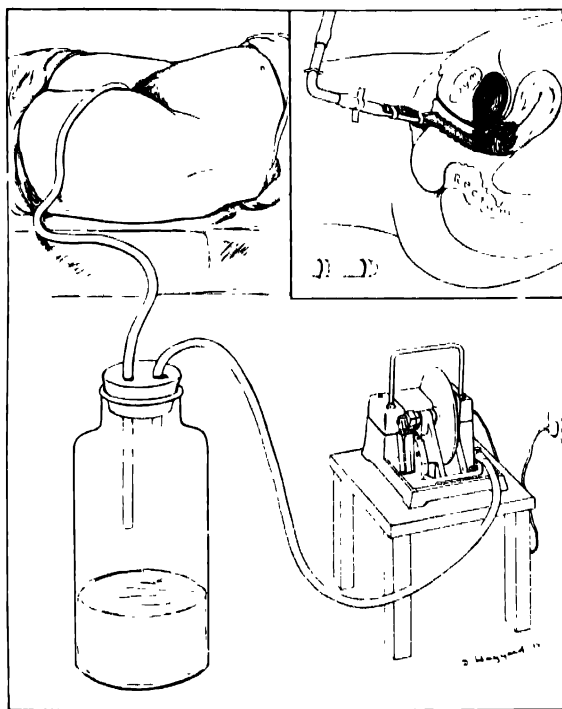
Fig. 539.—Suction drainage applied to vagina for urinary fistula. Tubing from catheter is led into a trap bottle to which mild suction is applied by means of a Stedman electric suprapubic pump. Insert in upper right shows gauze wick in vagina. The outer end of the gauze is held against the perforations in the end of the catheter. The catheter is taped on to the inner thigh and does not enter the vagina. (Saltzstein—Surg., Gynec. & Obst.)

In order to create an even sleeping surface, patients can make themselves comfortable by utilizing pillows. The consistency of the sponge rubber pad is such that the patient is not conscious of its presence when awake, and she can assume any position during the night and still remain dry.

The patient lies with her vulva overhanging the fenestration in the pad. The urine drops through the fenestration and is absorbed by the toweling, where it spreads out beneath the pad, and thus is not exposed to the patient's body heat. As a result, no offensive odor is produced. The following morning, the moist towels are removed, the pad and envelope are cleansed with a damp cloth, fresh towels replace the moist ones, and the apparatus is again ready for use. The rubber fails to absorb any odor from the urine.

The device was developed through the cooperation of Mrs. S. M., a patient in the Philadelphia Home for Incurables, who has been using it constantly for more than two

years. She had suffered from vesicovaginal and rectovaginal fistulas for more than eight years before she had the opportunity of using the present apparatus. She has found the bed pad to be the only satisfactory method for keeping herself dry at night.

Fig. 539 shows another type of apparatus for this purpose. It is an adaptation of continuous suction toward the solution of this difficult problem, and is presented by Saltzstein for the care of patients with vesicovaginal fistula from advancing cancer of the cervix. The following quotation is from his article, as are also the references to articles by Draper, Hendrickson, Kenyon, Lowsley, McCarthy, Stedman, and Tillotsen, which give a good survey of efforts in this direction.

When carcinoma of the cervix ulcerates into the floor of the bladder, a very disagreeable and uncomfortable condition ensues. To the infected necrotic cervix discharges is added the pooling of stagnant urine in the vagina, thus making this tender mucosa increasingly irritated, inflamed, and sore.

The care of this condition has been unsatisfactory. Transplantation of the ureters into the sigmoid has been considered, but at this stage of the disease the ureters are usually dilated from the stricture caused by cancer extension into the broad ligament, and the prognosis for length of life is too uncertain (2 to 6 months) to make this extensive operation practicable. Bilateral lumbar ureterostomy has been done occasionally with success.

The employment of a permanent urethral catheter will keep some patients dry if the hole in the bladder is high up near the cervix and is not too large. Very often the catheter soon irritates the urethra, however, and the patient demands its removal. Locally, we have tried to keep these patients comfortable by means of rubber sheet and double pads placed underneath the hips and thighs, and by giving them a supply of perineal pads which they may change as frequently as necessary (every 20 to 40 minutes). Some have used a sea sponge in the vagina. Others have used an inflated toy balloon.

Urologists have, during the past few years, made increasing use of continuous suction to carry off the urine from draining bladder wounds. The principles of applying suction to an open wound or orifice are that no vacuum be formed in the wound, and that there be no cupping action on the walls or bottom.

Various devices have been described to fit on to the body surface comfortably in order to dispense with drainage tubes or for use when these tubes are not needed. In all such devices a gauze wick lies in the urine or in the secretion to be absorbed. Air is sucked through a perforated catheter, tube, or mask attached to the gauze. The suction pulls the urine through the gauze, into the tubing, and then into a trap bottle.

The slightest suction or cupping pull in the vagina is painful, but a piece of gauze can be inserted into the vagina, attached to a perforated catheter outside the vaginal orifice, and the proper suction will transport the urine out into a bottle and keep the vagina clean. We have used the Hendrickson catheter attached to the Stedman electric suprapubic pump. This catheter ends in a flat spade-like tube, on one surface of which are 6 to 8 large perforations. A thick gauze wick is attached to this tube, and the free end is moistened and inserted three to four inches into the vagina. The catheter remains just outside the vagina. The tubing is then led over the patient's thigh to a gallon drain bottle on the floor. The pump is attached to the other tube of the bottle.

The vaginal wick must be changed as it becomes soiled, that is, every one or two days. No other care is necessary except the routine cleansing of tubing and bottle.

Operation.—Operation for vesicovaginal fistula should be undertaken only by those experienced in surgical work. Even a small fistula may be difficult to close, and is likely to be converted into a larger one by unsuccessful attempts. The operation must in each case be carefully planned, and be based on accurate knowledge of the relation of the fistula to the ureters and urethral sphincter and the extent of fixation of tissues to be used in repair. Details are given in the Operative Gynecology.

DISPLACEMENTS OF THE UTERUS

Points in Anatomy

The uterus is situated about the center of the pelvic cavity (Fig. 540) with the body of the organ inclined forward, the long axis of the organ being directed to a point above the symphysis pubis, the direction varying in different individuals and in the same individual at different times. The uterus is not fixed in one position, but can be moved easily in all directions—upward, downward, forward, or laterally. It is pressed somewhat backward in the pelvis when the bladder is distended and somewhat forward when the upper part of the rectum is distended.

It is clear, therefore, that the uterus possesses normally a considerable range of mobility, and it is only when it remains beyond the normal range that it can be said to be displaced.

What Holds the Uterus in Normal Position? As just stated, there is nothing that holds the uterus immovably in any one position. By a combination of several factors it is prevented, ordinarily, from going beyond certain limits, and is permitted free mobility within those limits.

The factors that thus assist in maintaining the uterus within normal limits are the pelvic floor, the broad ligaments, the uterosacral ligaments, the round ligaments, the normal weight and size of the uterus, and the normal tone and fullness of the pelvic tissues. The combination of supporting and balancing and guy-rope action of these structures is suggested by the somewhat similar combination in the working of a swing (Fig. 541).

Kinds of Displacement

There are three kinds of uterine displacement which constitute clinical entities requiring separate consideration, namely, retrodisplacement, prolapse, and inversion. Anteflexion of the cervix is the designation applied to the condition in which the cervix bends forward so that its axis is directed along the vaginal canal, instead of across it as normally. This condition is nearly always a developmental defect due to persistence of the fetal position of the cervix. The corpus uteri develops forward normally but the cervix fails to assume its normal direction. The simple position of the cervix causes no disturbance. The imperfect development is the important factor in the frequently associated dysmenorrhea and stenosis of the cervical canal, and hence the condition is best considered along with other developmental defects in Chapter XIII.

Anterior displacements of the corpus uteri and lateral displacements of the uterus occur only as incidental conditions in the course of other diseases, usually an enlarging tumor or abscess, and hence do not require separate consideration.
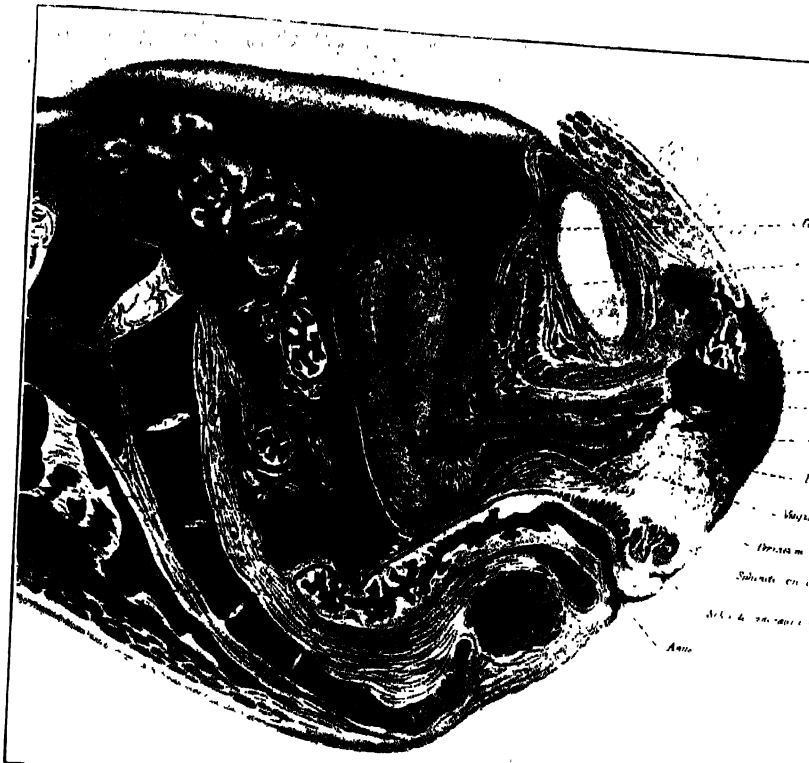
Fig. 540 —Section of a frozen body, showing the normal position of the uterus. (Sellheim–
Weibliches Becken.)

Chipman's Analogy of Uterine Supports

"Guy ropes"
(Round ligament)

Holding Apparatus
(Cardinal ligaments)

"Supporting Apparatus"
(Pelvic floor
accessory)
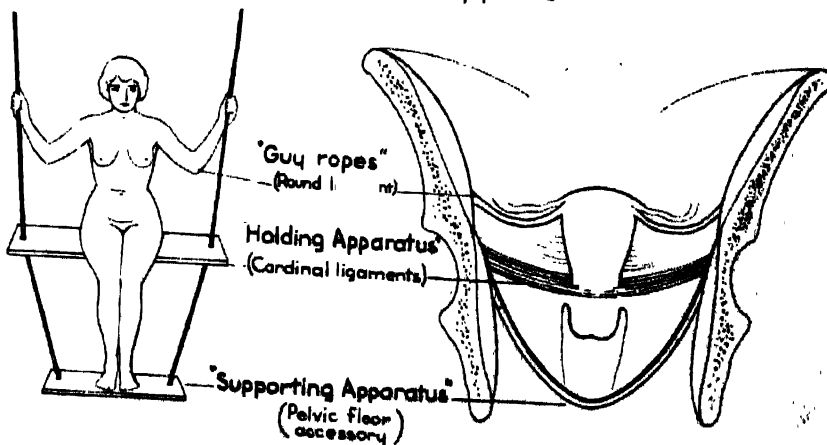
Fig. 541.—The coordination of supporting structures, which permit required movements of the uterus and yet hold it within normal limits, is well represented by the components of a swing supporting the body as in this illustration (Ward, after Chipman—*Southern Surgeon*).

RETRODISPLACEMENT OF UTERUS

Backward displacement of the uterus occurs in four forms. The most common form is shown in Figs. 542 to 544. It is a combination of version and flexion. The whole uterus is turned back to a certain extent and then the corpus is bent back still farther. If it is desired to go beyond the general diagnosis of retrodisplacement and specify the particular type, this common type could be designated "retroversioflexion." Occasionally a pure retroflexion, as shown in Fig. 545, or a pure retroversion as in Fig. 546 is encountered, but they are infrequent. There is a still rarer type, in which a uterus
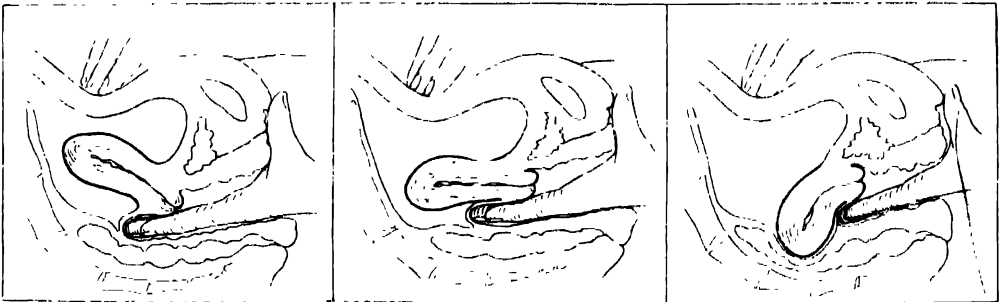
Fig. 542.   Fig. 543.   Fig. 544.

Figs. 542-544.—The three degrees of retrodisplacement of the uterus and the touch signs of each. Fig. 542, First degree— corpus out of reach of examining fingers, both above and below. Fig. 543, Second degree—vaginal fingers feel posterior surface of corpus uteri extending directly back. Fig. 544, Third degree— vaginal fingers impinge on corpus uteri turned down into the posterior cul-de-sac.
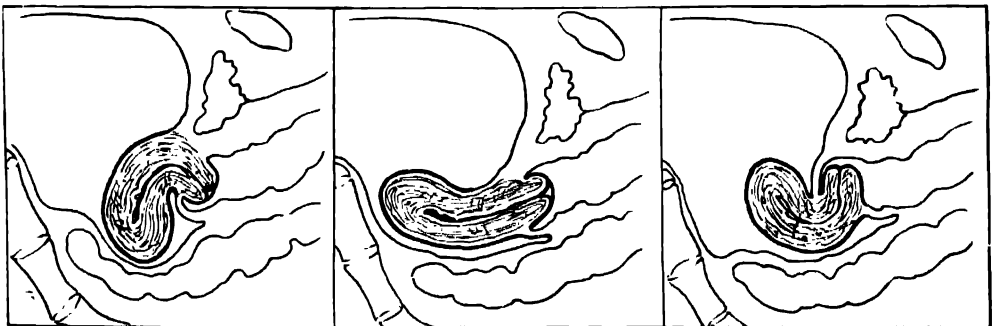
Fig. 545.   Fig. 546.   Fig. 547.

Figs. 545-547.—Retroflexion and retroversion of uterus. Fig. 545, Pure retroflexion, the corpus uteri being *bent* sharply back while the cervical axis is maintained in its usual relation with the vagina. Fig. 546, Pure retroversion, the whole uterus being *turned* back while the relation of the corpus to the cervix is undisturbed. Fig. 547, Retroversion of a uterus with an anteflexed cervix.

A pure retroflexion or pure retroversion is a rarity, nearly every case being a combination of the two, hence the use of the term "retrodisplacement" which covers both flexion and version.

with an anteflexed cervix becomes turned backward in the pelvis, as shown in Fig. 547. The descriptive designation of this would be "retroversion of uterus with anteflexion of cervix." It has been referred to as "retrocession," but that is only a general term meaning "a going back" and hence does not indicate the special condition present.

In general when the uterus is found back, the diagnosis should be "retrodisplacement of uterus," avoiding the terms "retroversion" and "retroflexion"

except in those cases in which the physician has béen able to examine deeply enough really to differentiate the different types. In many cases, owing to the difficulties of deep pelvic palpation, one is doing well to determine definitely that the uterus is retrodisplaced. "Retrodisplacement" is the term the authors shall use generally in referring to backward displacement of the uterus. It includes retroversion and retroflexion and any combination of the two.

Etiology

Retrodisplacement of the uterus may be due to causes connected with childbirth (relaxed floor, subinvolution) or to nonpuerperal causes, such as developmental defect or enlarging tumor. Developmental defect as an etiological factor is often overlooked. On account of imperfect development, the infantile position of the uterus persists to some extent. In such cases the imperfect tissue development of uterus and adjacent structures is likely to be a larger factor in the causation of symptoms than the simple backward position of the uterus.

Knowing that a large proportion of retrodisplacements are due to the stretching of the supports in childbirth and the backward tendency of the heavy subinvoluted uterus, preventive measures are employed. These consist of measures to aid normal involution of the uterus and adjacent tissues postpartum and avoidance of conditions which would interfere or which would put extra strain on weakened structures during the process of repair. The backward tendency of the heavy uterus is counteracted by (a) having the patient lie on the abdomen or side during convalescence rather than on the back and (b) beginning the knee-chest posture program after the pelvic blood-vascular system is sufficiently readjusted and stable to eliminate the danger of embolism —that is, in four to six weeks after delivery if the uterus is found in retrodisplacement on check-up examination at that time.

Falls may be disregarded as a cause of retrodisplacement of the normal uterus. As previously explained, the uterus is not fixed but is normally movable within wide limits, and provision is made for its return to the normal position after these physiologic excursions. The uterus is so well protected from jars and shocks that only a severe injury which breaks the protecting bony pelvis is at all likely to cause pathologic retrodisplacement, and then only through direct change in the adjacent structures by injury or exudate.

Pathology

The essential pathologic change is indicated in the name and in the definition. The amount of backward displacement may be very conveniently expressed as first or second or third degree. In retrodisplacement of the **first degree,** the fundus lies just about at the promontory of the sacrum, in the **second degree** the fundus lies in the hollow of the sacrum, while in the **third degree** it lies well down in the cul-de-sac below the level of the internal os (Fig. 544). Of course, in practice all gradations are found, from the normal position to the most marked backward displacement. The exact dividing line between the different degrees is not distinct and the division into first and second and third degrees is an artificial one, but it is convenient and usually cases on examination may be placed in one class or the other and so recorded.

Symptoms

The symptoms accompanying retrodisplacement of the uterus are due principally to the complications. There has been some question as to whether uncomplicated retrodisplacement causes any symptoms. In many cases where retrodisplacement is found it is clearly incidental, the symptoms being due to some other condition. It is important to recognize this fact and to differentiate accurately the cause of the patient's distress before subjecting her to operation or other troublesome treatment for the retrodisplacement. This incidental symptomless retrodisplacement is found principally in the nonparous and in the aged. In the active childbearing period the uterus is large and heavy, and troublesome discomfort may result from circulatory disturbance which in a less active uterus would be unnoticed. Consequently it is in such cases that correction of a movable retrodisplacement by pessary and knee-chest posture may give complete relief.

Retrodisplacement of the uterus may cause discomfort or may aggravate distress due to other lesions, the latter being the combination condition present in most cases requiring operation. The principal associated symptoms are menorrhagia, backache, leucorrhea, bladder and rectal distress, and sterility.

Diagnosis

The symptoms mentioned are common to many diseases and hence are not at all distinctive of retrodisplacement. The **diagnosis** of retrodisplacement must rest upon the physical examination. In examining the patient it is found usually that the cervix is lower and farther forward than is normal, and that it also points forward.

When making the bimanual examination, search is made for the body of the uterus in its normal location, by placing the ends of the fingers in the front of the cervix and pushing the cervix upward and backward and at the same time pressing the fingers of the other hand into the pelvis from above. In retrodisplacement it is not there so placing the vaginal fingers back of the cervix and making bimanual examination, a mass is found back of the cervix, which is about the size and shape of the body of the uterus and apparently continuous with the cervix.

If the uterus is in only the first degree of retrodisplacement (Fig. 542), the fundus may be so high as to be out of reach of the vaginal fingers, and yet far enough back to be out of reach of the fingers above. The difficulty is much increased if the patient holds the abdominal muscles tense. In these cases the body of the uterus may sometimes be raised so that it can be felt by the abdominal hand by pushing up the cervix with the fingers in the vagina. This lifts the whole uterus—body and all. If the displacement is marked (that is, second or third degree), the fundus can usually be felt by the vaginal fingers, back of the cervix (Fig. 544). When a mass is felt in front or behind the cervix, it must then be determined whether or not the mass is the corpus uteri. Figs. 548 to 559 show the principal conditions that must be taken into consideration in the differential diagnosis.

The differential diagnosis is made by making out the position, size, shape, consistency, tenderness, mobility and attachments of the mass, as explained under Gynecologic Examination (Chapter II).

Determine Mobility.—After having determined that the body of the uterus is backward, and about how far backward, the next point to determine is whether or not it is freely **movable.** The vaginal fingers are pressed well in
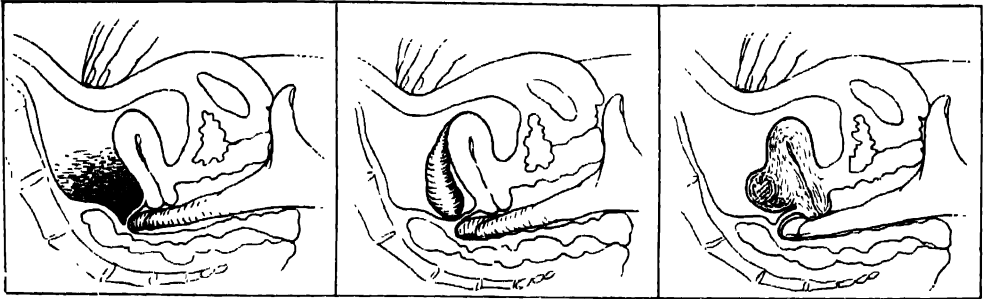
Fig. 548.   Fig. 549.   Fig. 550.

Figs. 548-550.—Differential diagnosis of retrodisplacement of uterus. Conditions simulating retrodisplacement. Fig. 548, Inflammatory exudate in the cul-de-sac, which may be mistaken for retrodisplacement when corpus uteri is not identified above on account of a thick or tense abdominal wall Fig. 549, Tubal mass in cul-de-sac simulating the corpus uteri in that situation. Fig. 550, Myoma of the posterior uterine wall which may cause considerable difficulty in differential diagnosis from retrodisplacement.
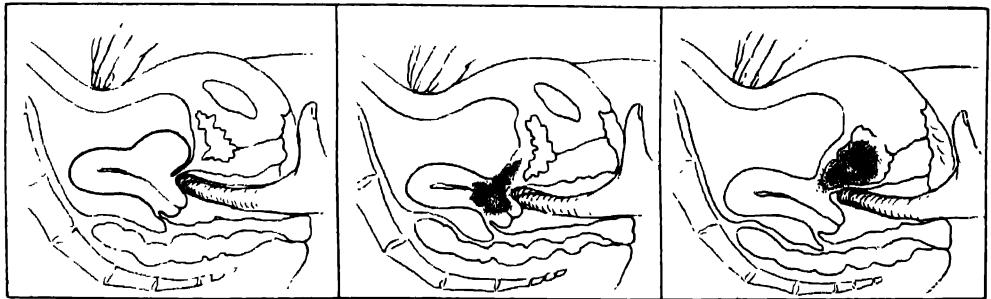
Fig. 551.   Fig. 552.   Fig. 553.

Figs. 551-553.—Differential diagnosis of retrodisplacement of uterus. Conditions that may obscure a retrodisplacement. Fig. 551, Myoma of anterior uterine wall that simulates the corpus uteri. Fig. 552, Uterine carcinoma with infiltration in front of cervix that may be mistaken for the resisting corpus uteri. Fig. 553, Tumor of bladder that gives a resisting mass in the general position of the corpus uteri.
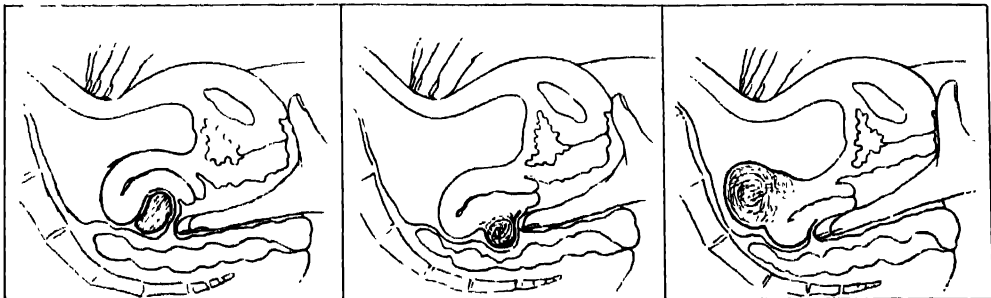
Fig. 554.   Fig. 555.   Fig. 556.

Figs. 554-556.—Differential diagnosis of retrodisplacement of uterus. Complicated cases of retrodisplacement. Fig. 554, Adnexa prolapsed under the retrodisplaced uterus. Fig. 555, Myoma in the posterior wall of the retrodisplaced uterus. Fig. 556, Myoma on the anterior part of the fundus of the retrodisplaced uterus.

under the fundus, and an attempt is made to lift it (Figs. 560 to 563). If it cannot be raised from its position, it is fixed. The fixation may be due to adhesions or to the fundus being caught under the promontory of the sacrum. To determine which condition is present, catch the cervix with the tenaculum forceps and pull it downward and forward (Fig. 564). This maneuver pulls the uterus forward and away from the promontory. Then, while holding the uterus in that position, the fundus may be lifted past the promontory (Fig. 565), provided it is not otherwise held. If the uterus still cannot be raised, it is probably **adherent**—i.e., fixed in its false position by adhesions, the result
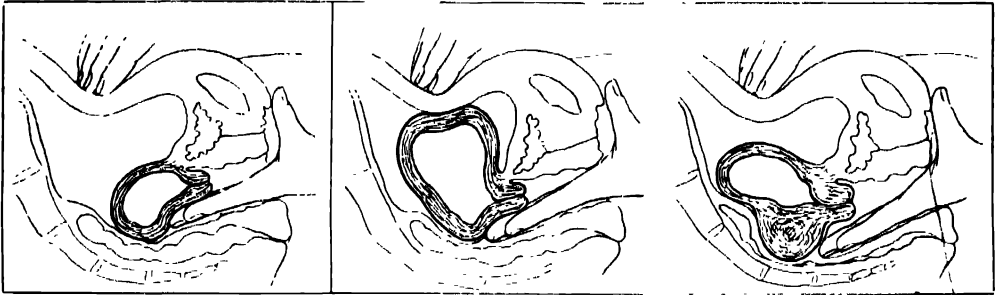
Fig. 557.   Fig. 558.   Fig. 559.

Figs. 557-559.—Differential diagnosis of retrodisplacement of uterus Confusing conditions associated with early pregnancy. Fig. 557, Retrodisplacement with early pregnancy. Fig. 558, More advanced pregnancy with sacculation of the softened wall posteriorly. Fig. 559, Retrodisplacement with early pregnancy and a myoma in the posterior uterine wall. Keeping the possibility of such troublesome combinations in mind will often save an embarrassing mistake in diagnosis.
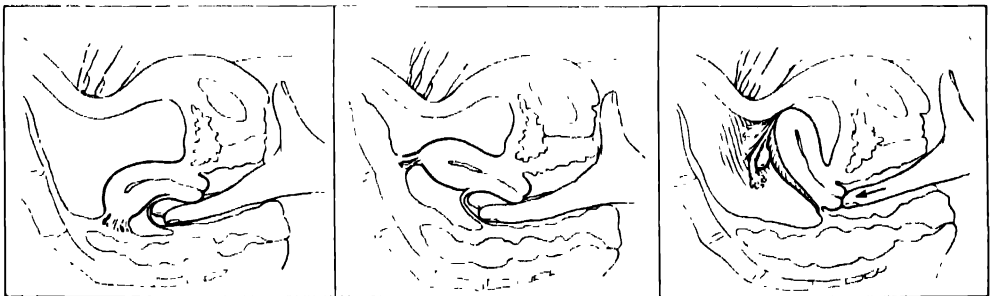
Fig. 560.   Fig. 561.   Fig. 562.

Figs. 560-562.—Determining the presence and extent of adhesions in retrodisplacement of the uterus. Fig. 560, The fundus uteri adherent low posteriorly. It cannot be gotten away from this region. Fig. 561, Adhesions higher. These usually permit considerable movement of the fundus uteri but it cannot be raised high enough to be caught with the abdominal fingers. Fig. 562, Light adhesions in the adnexal region. The fundus can usually be raised high enough to be caught with the abdominal fingers but does not come well forward or will not stay forward when released.

of inflammation. This probability is increased if there is evidence of inflammation about the tube on either side.

There is one other condition that may cause the uterus to be held in its backward position. Sometimes when the fundus lies low in the cul-de-sac, the sacro-uterine ligaments produce some constriction above it and prevent its return. This action of the sacro-uterine ligaments is increased if the cervix be strongly pulled upon. This is a rare condition and is possible only when the uterus is in the third degree of retrodisplacement.

Complications.—There are several conditions that frequently accompany retrodisplacement and that must be taken into consideration. For example, relaxation of the pelvic floor, chronic cervicitis, endometrial hyperplasia, chronic metritis, salpingitis with or without exudate and adhesions, and tumors of the uterus or adnexa.

The last two mentioned may cause trouble in determining the exact location of the body of the uterus. In examining a patient, do not stop when you find one lesion, but make a thorough examination and find all the lesions present.

Treatment

If there are no symptoms, no treatment is needed. But the patient should be kept under observation so that if symptoms do develop, effective treatment may at once be instituted before the case has run along and developed complications.

The treatment to be adopted depends on whether the uterus is movable or adherent.

WHEN THE UTERUS IS MOVABLE

In a case of retrodisplacement with movable uterus, the first step in the treatment is to **replace the uterus** to its proper position. There are two ways of doing this—by bimanual manipulation or by employment of the knee-chest posture.

Bimanual Replacement.—By the manipulation employed in the bimanual examination, the uterus is often replaced.

If it cannot be replaced by the ordinary bimanual examination methods, then catch and draw down the cervix with a tenaculum forceps (Fig. 564), and raise the fundus as high as possible with the fingers in the vagina. Then press the abdominal hand deeply into the back part of the pelvis, locate the promontory, and work along it into the pelvis back of the uterus (Figs. 565, 566). The fundus uteri is then brought forward and at the same time the cervix is carried backward, as shown in Fig. 567. After bringing the fundus forward, bend it well down over the vaginal fingers as shown in Fig. 568, in order to take out any backward flexion that may be present.

To carry out these manipulations successfully, the abdominal walls must be relaxed and the uterus not very tender. If the patient has a thick layer of adipose tissue, the examining fingers sometimes cannot get near enough to the uterine body to manipulate it satisfactorily. If the patient holds the abdominal walls tense, on account of pain or nervousness, the abdominal fingers cannot reach the uterus. If the uterus is inflamed and tender, the pressure necessary to these manipulations causes too much pain.

Knee-Chest Posture.—When the uterus, though movable, cannot be replaced by the bimanual manipulations, the knee-chest posture may be used. After the patient has been placed in this position (with the clothing about waist thoroughly loosened), the Sims speculum is introduced. The cervix is then caught with the tenaculum forceps and pulled forward. This brings the fundus uteri out from the promontory and permits it to fall forward into its proper position.

The cervix is then pushed well backward into the hollow of the sacrum, and a pessary or packing is put in to hold it there.

The old method of replacement by sound or repositor is mentioned only to be condemned. The sound or intrauterine repositor used in this way is dangerous. A uterus that is not adherent can usually be brought forward by one of the two methods already mentioned. In a uterus that is adherent the use of a sound or repositor is liable to lead to inflammation or perforation of the uterus.
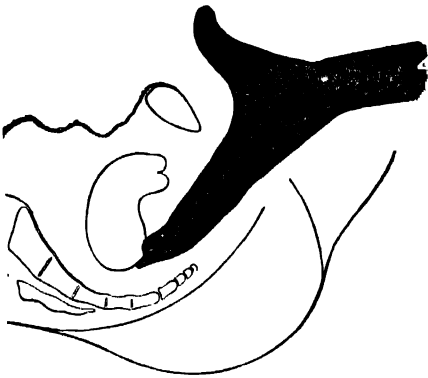
Fig. 563.
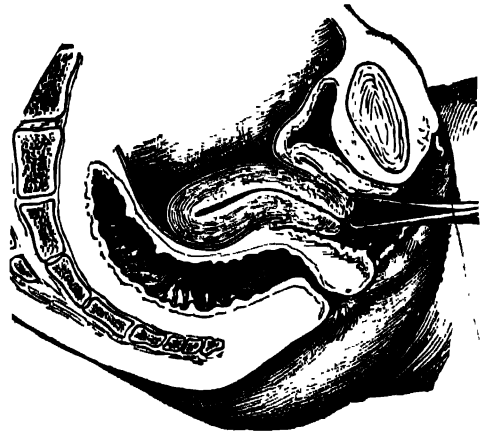
Fig. 564.

Fig. 563.—Attempting to raise the fundus uteri, to determine whether or not it is fixed. This is also the first step in bimanual replacement of the uterus. (Pryor—*Gynecology*.)

Fig. 564.—Bimanual replacement. Catching the cervix and pulling forward the uterus, so the fundus will be clear of the sacral promontory. (Kelly—*Operative Gynecology*.)

Fig. 565.

Fig. 566.

Fig. 565.—Bimanual replacement. Raising the fundus uteri past the sacral promontory. (Pryor—*Gynecology*.)

Fig. 566.—Bimanual replacement. Working the abdominal fingers down over the sacral promontory, so as to get behind the fundus uteri and bring it forward. (Pryor—*Gynecology*.)

In some cases the uterus and adjacent tissues are too tender to permit the manipulations necessary for replacement. In such a case, hot vaginal douches, purgatives, and the knee-chest posture morning and evening for a few days may diminish the tenderness very much. In such a case, after the knee-chest

posture has been taken morning and evening for a few days, the uterus may be found forward at the next examination.

The Pessary.—After the uterus has been replaced, then comes the problem of holding it there. The most convenient and efficient device for this purpose is the pessary. In uncomplicated cases this is often all that is needed.

Fig. 567.

Fig. 568.

Fig. 567.—Bringing the fundus uteri forward and pushing the cervix backward and upward (Kelly—*Operative Gynecology.*)

Fig. 568.—The uterus brought forward into position. This shows also the method of taking the backward flexion out of the uterus by bending it firmly forward over the vaginal fingers. (Kelly—*Operative Gynecology.*)

Varieties of Pessary

Innumerable forms have been recommended, and to attempt to mention all of them would be a waste of time. They have long been made of hard rubber and are now available in translucent plastic material. With the new chemical plastics as well as with the rubber pessaries, watch should be kept for possible allergic reaction with allergic patients. Both the hard rubber and the plastic pessaries may be molded by heating in hot water, thus permitting some adjustment to special conditions.

The following three forms are the principal ones used at present in the treatment of retrodisplacement, and they are sufficient in practically all cases in which a pessary is the preferable method of treatment.

1. **Hodge Pessary** (Fig. 569, *A*).—This pessary, devised by Hugh L. Hodge, professor of Diseases of Women in the University of Pennsylvania from 1835 to 1863, may be taken as the type of the hard rubber ring pessaries. It is the original model from which nearly all other pessaries of that character descended. It is still much used and, as explained later, is the most suitable one for certain conditions.

2. **Albert Smith Pessary** (Fig. 569, *B*).—Albert H. Smith modified the Hodge pessary in two important particulars. He narrowed the anterior end so˙ that it fits well up into the narrow portion of the pubic arch, the point

projecting slightly into the arch. This tends to keep the pessary from turning or slipping about in the vagina and at the same time causes the anterior part of the pessary to lie higher—so that it is out of the way and does not interfere with coitus or with the introduction of a douche nozzle. His other modification was a lengthening of the posterior arm of the pessary. This pushes the posterior vaginal fornix further upward and backward, thus increasing the ability of the pessary to hold the cervix uteri well back in the pelvis.

3. **Thomas Pessary** (sometimes called the Smith-Thomas pessary).—T. Gaillard Thomas modified the Smith pessary by thickening the posterior end into a bulbous enlargement. This distributes the pressure over a larger surface of the posterior fornix.
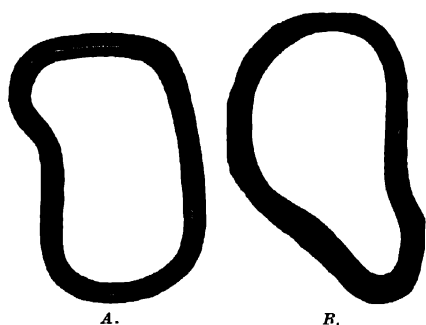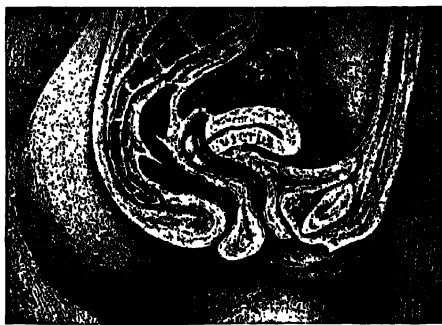
Fig. 569.   Fig. 570.

Fig. 569.—*A*, The Hodge pessary. *B*, The Albert Smith pessary.

Fig. 570.—The pessary in place. The action of the pessary is to hold the posterior vaginal fornix, and with it the attached cervix, well backward and upward in the pelvis. (Skene—*Diseases of Women.*)

Action of the Pessary

The action of the Hodge pessary and its modifications, as ordinarily used in a case of retrodisplacement, is to **hold the cervix back** in the hollow of the sacrum (Fig. 570). As long as the cervix is held well back in the pelvis, the fundus uteri will stay forward where it belongs. The pessary holds the cervix uteri back in place by holding back the posterior vaginal vault (to which the cervix is closely attached) and also by pushing upward and backward on the sacro-uterine ligaments, thus putting them on the stretch. To accomplish this, the anterior portion of the pessary must have a rather firm support, which it gets from the pubic arch (with intervening soft tissues) and the pelvic floor.

The action of the pessary, with its many curves, seems to be a veritable puzzle to many students and to not a few practitioners, yet it is clear enough when properly approached and studied. The principle of action is the same as though a straight stick extended from the pubic arch to the posterior vaginal vault. As long as the anterior end of the stick is supported by the pubic arch, neither the posterior vaginal fornix nor the cervix, which is closely attached to it, can approach the vaginal outlet. The cervix can move up and down through a small arc, but it cannot come any nearer the vaginal outlet and consequently as the cervix is held well back in the pelvis the fundus uteri stays forward.

This is practically the action of the pessary. It takes its fixed **point of support** from the **pubic arch** (the soft tissues intervening), being held up against the narrow part of the arch by the **pelvic floor**. As long as the anterior end of the pessary is properly supported (held stationary), the posterior end holds the posterior vaginal vault and the attached cervix well back in the pelvis. The ring shape of the pessary and the various curves are simply to adjust it comfortably to the adjacent structures. The open ring permits the cervix to project through the pessary, the sides to lie well out of the way in the lateral angles of the vaginal canal, and the uterine secretion to flow outward without hindrance.

The marked upward bend of the posterior portion of the pessary increases its ability to push the posterior vaginal fornix upward and backward and put the sacro-uterine ligaments on the stretch. The long upward curve of the front part of the pessary with the narrow anterior end permits the anterior end to lie up out of the way in the narrow part of the arch, and also furnishes a slope against which the perineum and front part of the pelvic floor act advantageously, helping to support the pessary in both an upward and backward direction and thus taking some of the pressure off the extreme anterior end.

When the pelvic floor is severely torn, it permits the pessary to sink lower in the pelvis. The anterior narrow end lies at a wide part of the arch, a part too wide to furnish support for it and it slips outside a short distance. This permits the cervix to come forward and then the fundus goes backward. In such a case, if we use a pessary with a wider anterior end (e.g., the regular Hodge pessary) it, being wider, impinges on the sides of the arch and holds the cervix back where it belongs. In very severe laceration, the marked relaxation of the pelvic floor allows the pessary to come so low—to such a very wide part of the arch—that not even the Hodge pessary will stay in. In such a case some temporary relief may be given by other styles of pessary to be mentioned later.

Selection of Pessary

The selection of the pessary best adapted to a particular case concerns the style, size, and special modifications.

As to **style** or form, in retrodisplacement the authors prefer the Smith pessary (Fig. 569, *B*), in all but exceptional cases.

The exceptional cases in which this pessary may not be satisfactory are as follows:

Where there is a severe laceration of the pelvic floor. In these cases a pessary with a wider anterior end is required, as previously explained. Here the regular Hodge pessary is usually the preferable one. In lacerations of extreme severity, where the parts are so relaxed that neither the Hodge nor Smith pessary will stay in, the inflated ring pessary or one of the other forms mentioned under Prolapse may give some temporary relief. For permanent relief in such a case operative measures are required.

When there are painful inflammatory lesions about the uterus or a prolapsed and tender ovary. As a rule, however, in such cases time spent with pessaries is time wasted, as far as any permanent relief is concerned.

As to the **size** of pessary to be selected, the approximate length may be determined by measuring with the examining fingers the distance from the posterior vaginal vault (pushed well up) to the pubic arch. The length of the pessary should be a trifle less than this. The width of the pessary which the vagina will accommodate may be determined approximately by the apparent roominess of the vagina as felt in vaginal palpation.

However, the size of pessary that will keep the uterus in position with the least discomfort can be determined certainly only by trial, and several pessaries may have to be worn for a short time before the most satisfactory one for that particular case is settled upon. A pessary that is too small fails to hold the uterus in position and tends to slip out. A pessary that is too large causes pain.

The **special modifications** refer to slight changes in shape from the regular form, occasionally required to make the pessary more comfortable or more satisfactory in retaining the uterus in position.

1. GENERAL NARROWING of the pessary. The pessaries as purchased maintain a ratio between the width and the length (the longer the pessary the wider it is). As a rule this is desirable. In some cases, however, the vaginal opening is too small to admit a pessary of sufficient length. To overcome this difficulty, drop the pessary in boiling water (e.g., in the instrument sterilizer) until it becomes slightly pliable, then remove it with a forceps, grasp it with a towel, and squeeze it so as to narrow it laterally to the required extent, and hold it thus until it cools, the cooling being hastened by allowing cold water to run over it. Do not keep it very long in the hot water or it will become so pliable that it flattens into a simple ring, which is not desirable unless a very extensive reshaping is required.

The Findley folding pessary is a hard-rubber pessary of the Smith form which has a soft-rubber insertion at each end, thus permitting the pessary to be narrowed or folded for introduction by simple squeezing as it is introduced, the pessary returning to its original shape when inside. It is convenient when a patient with a small vaginal opening requires a long pessary. Experience with flexible rubber pessaries, however, would indicate eventual hardening and cracking of the flexible ends.

2. LOCAL BENDING. When softened in boiling water, the hard-rubber pessary may be modified in shape in various ways to adjust it to special conditions, such as a tender spot to be avoided or a condition requiring increase or diminution of the longitudinal curves.

Pessary Used Only After Replacement

The pessary is ordinarily not used until the uterus has been brought forward. The pessary is not, as many suppose, used to push the fundus uteri forward, neither is it used to prop the fundus forward. The pessary has nothing to do directly with this part of the uterus. All the pessary does is to hold the cervix well back in the pelvis, as previously explained, and then in the ordinary state of affairs the fundus must stay forward.

There are **some exceptions** to the rule that a pessary is used only after replacement. In some cases of roomy pelvis, in which it is difficult to raise a movable fundus uteri because it gets out of reach, a pessary may be used somewhat as an extension to the finger, to help raise the fundus within reach of the abdominal fingers.

Again, in a case of movable uterus which cannot be brought forward satisfactorily, if a pessary is introduced and the patient instructed to take the knee-chest posture twice daily, the uterus may be found forward at the next examination a few days later.

Introduction of the Pessary

Ordinarily the pessary is introduced with the patient in the dorsal posture, immediately after the uterus has been brought forward by bimanual reposition, as already described.

Before introducing a pessary, cleanse it thoroughly in an antiseptic solution and then lubricate it with a suitable ointment. In introducing it into the vaginal opening, if the opening seems rather small, put one finger in the vagina and depress the perineum strongly to make room for the pessary. Remember, in introducing a pessary or speculum or the examining fingers into the vagina, if the opening seems small and more room is desired, the pressure must always be made backward, depressing the perineum. The least pressure forward will pinch the tissues against the pubic arch.

The introduction or placing of the pessary is carried out as follows: Hold the pessary by the anterior end, depress the perineum well with one finger (Fig. 571) and introduce the posterior end with the breadth of the pessary lying in the anteroposterior diameter, which is the largest diameter of the opening. The pessary should be held somewhat obliquely so as not to make painful pressure on the urethra (Fig. 572). When the pessary is about half-way in (Fig. 573), turn it so that the breadth of the pessary lies laterally (Fig. 574), and the posterior arm is directed upward. Then push the pessary along until it will not go any farther. It stops because the posterior end is against the anterior lip of the cervix. Then introduce a finger into the vagina beneath the pessary, catch the posterior bar with the finger tip (Fig. 575), depress it (Fig. 576) and then push the pessary past the cervix. Fig. 570 shows the pessary in place.

After the pessary is in place it is well to have the patient walk about the room a little, to see whether there is any discomfort. If there is any decided pain or marked discomfort, try a smaller size or another form.

Instructions to Patient With Pessary

The care of a patient having a pessary in place includes the following points:

Visits to the Physician.—When the pessary is introduced the patient is directed to return in a week, or before if there is any pain. There is more or less uncertainty for the first week or so, as to just how the pelvic structures will accommodate themselves to a pessary. For that reason it is well to in-

Fig. 571

Fig. 572

Fig. 571.—Introducing the pessary. First step—depressing the perineum.

Fig. 572.—Introducing the pessary through the vaginal opening. The width of the pessary lies in the anteroposterior diameter of the opening, which is the long diameter, but is turned somewhat obliquely to avoid the urethra.

Fig. 573.

Fig. 574.

Fig. 573.—Introducing the pessary. The pessary is turned so the width lies transversely, for the transverse diameter is the long diameter of the vaginal canal, though not of the vaginal entrance. The pessary is then pushed in until its further progress is stopped by the cervix.

Fig. 574.—Introducing the pessary. The pessary is now well within the vagina and ready for turning.

struct the patient to return at once if any unusual pain is felt or if the pessary appears to slip out of position.

When the pessary is found satisfactory at the second and third visits, it is to be assumed that it will prove satisfactory right along, and as long as the patient feels well she need not return, except every month or six weeks as conditions indicate. This return at regular intervals of a few weeks is important in every case (though, exceptionally the intervals may be longer) for three reasons—(a) because the pessary is liable to accumulate concretions that may prove irritating, (b) because long-continued pressure may produce irritation at some point in the posterior vaginal fornix, and (c) because it is important to know whether the pessary is doing the work it is used for, and whether everything is going as it should. Injurious pressure on the wall is indicated by a distinct groove or ridge with infiltration in the affected area. When such is present, the pessary should be left out for a few weeks or a different form used. If necessary to leave the pessary out for a time, the knee-chest posture night and morning is to be employed.

Fig. 575.

Fig. 576.

Fig. 575.—Introducing the pessary. The index finger is passed to the top of the posterior end, which is then depressed until it can be pushed past the cervix, as shown in Fig. 576.

Fig. 576.—Introducing the pessary. The posterior end depressed and being pushed past the cervix. The pessary is shown in place in Fig. 570.

Douches.—The patient wearing a pessary should take a vaginal douche every day or every few days. If the discharge is very free, it may be advisable to take two douches daily. If there is practically no discharge, two douches weekly may be sufficient. Ordinarily the patient is directed to take a douche once daily or every other day.

Knee-Chest Posture.—The knee-chest posture (Fig. 329), taken by the patient night and morning, is very useful in those cases in which the uterus tends to return to its old position or in which the patient complains of downward pressure in the pelvis. It causes the patient some inconvenience and is not necessary when the pessary holds the uterus well up and entirely relieves the symptoms. But in many cases of damaged pelvic floor, its use along with the pessary is very advantageous.

The **activity of the patient** need not be curtailed on account of the pessary. The pessary is meant to hold the uterus in proper position and restore the patient to comparative health, so that she can pursue her usual activities without disturbance. If the patient cannot pursue her usual activities after the pessary has been worn a month or two, the pessary has failed of its purpose, and some more effective method of treatment is indicated.

In some cases, the replacement of the uterus and wearing of the pessary are carried out principally to increase the chance of pregnancy, and in such cases coitus is permissible from the first. It is well to mention this fact to the patient or her husband, as otherwise it may be thought that coitus is not possible while the pessary is in place.

If pregnancy should develop, the pessary should be worn just the same until the uterus has become large enough to prevent its sinking back into the pelvis. The douche should then be taken only warm—not hot, for a hot douche may excite uterine contractions and lead to miscarriage. Usually along in the third or fourth month the pessary is taken out, as it is of no further use, and if left in longer it might cause irritation and disturbance.

Occasionally a pessary excites pain shortly after pregnancy takes place. If so, it should be removed, the patient being directed to take the knee-chest posture two or three times daily, to keep the fundus uteri forward.

When to Discard the Pessary

The time at which the pessary may be discarded varies much in different cases, and in each case is more or less a matter of trial. A very good rule is to leave out the pessary after the uterus has remained in position continuously for six months. Direct the patient to return in a few days. If the uterus has returned to its old backward position, replace it and use the pessary again for several months.

If the uterus maintains its forward position without the pessary, direct the patient to return again in two weeks. If then the uterus is in proper position and the patient is feeling well, she may be discharged, being directed to return if symptoms should at any time reappear.

The Inflated Ring Pessary.—The action of the inflated ring pessary is principally to raise the uterus and adjacent tissues somewhat and to support them. It has no particular action in holding the cervix well back in the pelvis nor in maintaining the uterus in a proper forward position. Consequently, the field of usefulness of this particular form of pessary is in those cases in which the uterus cannot be got into the forward position or cannot be maintained there. The simple supporting of the uterus, thus overcoming the slight prolapse which is present in most cases of retrodisplacement, often gives the patient much relief, though the retrodisplacement has not been corrected.

Persistence of Symptoms

The effect just noted of the simple support of the uterus serves to show the importance of the slight PROLAPSE in these cases and serves to show also that the retrodisplacement, as a factor in the causation of the symptoms and as a factor to be considered in the treatment, is not of such exclusive impor-

tance as one might infer. The relief that follows operative replacement and permanent correction of the retrodisplacement is due, to a large extent, to the simultaneous elevation of the uterus and adnexa.

When there are troublesome symptoms that are not relieved by the measures previously mentioned, operative treatment is required. The various classes of operative measures are mentioned further along.

In order that the operative treatment may prove satisfactory, the patient should be put through a most careful and thorough pelvic examination, that the exact cause of the persistence of the displacement may be accurately determined, and the form of operative treatment selected accordingly.

In a large proportion of the patients who have borne children, there will be found a relaxed condition of the pelvic floor and of the broad ligaments and sacro-uterine ligaments. It is evident that in such a case the simple bringing of the fundus uteri forward and fastening it there is only a small part of the necessary work. The pelvic floor must be strengthened, and some means must also be used to lift up the uterus and thus overcome the prolapse due to the relaxation of all the supports of the organ. In many of these cases the uterus is large and heavy from subinvolution or other pathologic process.

WHEN THE UTERUS IS ADHERENT

When the fundus uteri cannot be brought forward by the methods previously described and no tumor that is responsible for the fixation can be felt, it is assumed that the uterus is "adherent," i.e., held in its abnormal position by the products of pelvic inflammation, affecting the tube or the peritoneum or the connective tissue. The fixation may be so close that the fundus cannot be moved appreciably, or it may, on the other hand, permit considerable movement in various directions, but not enough to allow the fundus uteri to be brought entirely forward.

For the purposes of treatment it is convenient to divide these cases of adherent retrodisplacement into two classes—(1) those in which the inflammation is acute or subacute, and (2) those in which it is chronic or has practically disappeared, leaving only the sequelae.

Inflammation Acute.—These cases present, in addition to the retrodisplacement of the uterus, the usual symptoms and signs of acute or subacute pelvic inflammation. The symptoms presented by the patient are due principally to the inflammation, and the treatment is at first directed wholly to that.

When the inflammation subsides, the troublesome symptoms may disappear to such an extent that no treatment for the retrodisplacement is required. It is the relief of pain and discomfort that the patient seeks and when this can be secured simply by the relief of the inflammatory trouble, it is not necessary to disturb the uterus. In fact, as a rule, anything in that direction short of removal of the inflammatory focus will tend to stir up again the troublesome symptoms.

Operation is required, however, in a majority of these cases sooner or later, either because of a persisting focus of inflammation, with chronic invalidism, or because of the sinking and dragging of the heavy retrodisplaced uterus on the damaged and sensitive adnexa or adjacent structures. In the

case of a partially movable uterus, the wearing of a pessary (for example, the inflated ring pessary) that holds the heavy uterus up, will sometimes give considerable relief. Such a pessary prevents the constant dragging of the uterus on its supports and on the sensitive adnexa, and in that way gives relief, though there is no correction of the retrodisplacement.

Chronic Inflammation.—In the chronic cases, fixation of the retrodisplaced uterus is usually due to inflammation beginning in a fallopian tube; consequently it is frequently accompanied by salpingitis and an inflammatory exudate involving one or both tubal regions. There may be a collection of pus in a tube or in the mass of exudate about the tube, or there may be only a mass of inflammatory exudate without pus, or there may be only adhesions. If the previous inflammation was in the connective tissue, there will be infiltration remaining from the pelvic cellulitis (parametritis). In either case, the uterus is found in an abnormal position and cannot be replaced by the methods previously described.

In these cases, considerable relief may be given by measures that tend to allay the accompanying pelvic inflammation and that stretch the adhesions and that support the uterus to some extent. However, such complications giving active trouble usually require operation.

In cases with only old adhesions holding the uterus, manual stretching of the adhesions by repeated slow pressure to raise the fundus may eventually be effective in replacement. When a more evenly distributed gradual pressure is advisable, as in cases of pregnancy with retrodisplacement, a long bag containing mercury may be used with the knee-chest posture. The empty end of the bag is slipped into the vaginal vault and then the mercury allowed to fill it, the pressure to be maintained over a considerable period depending on conditions and the patient's reaction.

Operative Treatment

The objects of the operative treatment are two: first, the removal of products of inflammation and of damaged organs as far as necessary and, second, the lifting and bringing forward of the body of the uterus and fastening it. This requires major operative work.

Fig. 4 shows the course of the round ligaments, the shortening of which in various ways constitutes the usual special step in retrodisplacement operations. At first the shortening of the ligaments was carried out extraperitoneally by opening the inguinal canal on each side, the first successful operation being performed by Alexander of Liverpool in 1881.

Later, when the advances in antiseptic and aseptic technique reduced the high mortality of intraperitoneal work, the ligament shortening was carried out by intraperitoneal operation. This enabled coincident surgical treatment of the associated inflammatory lesions which rendered so many retrodisplacement cases not amenable to extraperitoneal shortening.

The type of retrodisplacement due to imperfect development of the uterus from the infantile position may not cause any trouble requiring treatment. But if there should be associated symptoms and correction be attempted, permanent correction is likely to be found difficult because of the general tissue

fixation and the poor development of the structures used to maintain correction. In these cases, endocrine treatment to promote further development is indicated in addition to any mechanical means employed.

PROLAPSE OF THE UTERUS

Prolapse of the uterus is that condition in which the uterus sinks decidedly below its normal level in the pelvis and appears at or near the vaginal opening. It is known also as "procidentia," and is frequently referred to by patients as "falling of the womb."
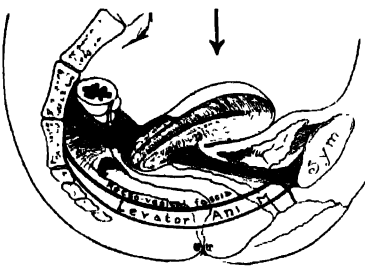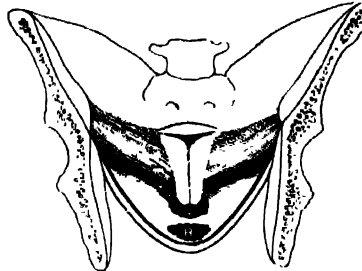
Fig. 577.   Fig. 578.

Fig. 577.—The upper diaphragm and the lower diaphragm of the pelvis, showing the sling action anteroposteriorly. In the upper diaphragm, the anteroposterior sling is formed by the uterosacral ligaments posteriorly and the uteropubic fascial plane anteriorly. In the lower diaphragm, the anteroposterior sling, indicated here diagrammatically, is formed by the levator ani muscles and surrounding fasciae, with supplementary muscles in front and behind.

This illustration indicates also the deflecting action of the corpus uteri, which receives the intraabdominal pressure upon its posterior surface and distributes it toward the margins of the supporting diaphragm.

Fig. 578.—The upper diaphragm and the lower diaphragm of the pelvis, showing the sling action transversely. In the upper diaphragm the transverse sling is formed by the broad ligaments, and particularly by the strong supporting structures forming the lower portion of the broad ligaments. In the lower diaphragm, the transverse sling is formed by the levator ani muscles and surrounding fasciae, shown here diagrammatically. (Crossen and Crossen—*Operative Gynecology.*)
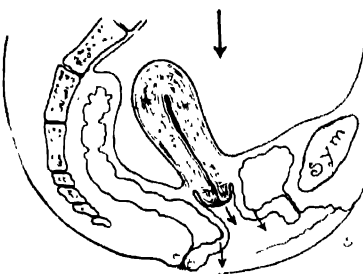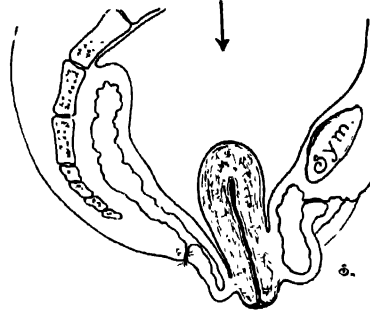
Fig. 579.   Fig. 580.

Fig. 579.—Disarrangement of the deflecting mechanism by retrodisplacement of the corpus uteri, accompanied by relaxation of the pelvic floor. In the presence of such conditions, the development of prolapse is ordinarily only a question of time, for there is no adequate resistance to intra-abdominal pressure.

Fig. 580.—Prolapse of uterus and bladder developed. The intra-abdominal pressure tends to push the structures farther and farther out of the pelvis. (Crossen and Crossen—*Operative Gynecology.*)

Etiology

The largest factor in the origin of uterine prolapse is the **great stretching** of the birth canal and adjacent tissues incidental to the passage of the child in parturition. The component structures of the pelvic floor have already been described and illustrated, and the supravaginal supporting diaphragm of

muscular and fibrous structures is shown in Figs. 577 and 578. Subinvolution of these stretched tissues is an important item in their remaining loose and nonsupportive. Open tears may contribute some, but not much when repaired at the time.

Retrodisplacement of the uterus is another factor contributing to prolapse. Retrodisplacement disarranges the positional combination which is an important aid in the supporting mechanism. When the uterus is forward in normal position, intra-abdominal pressure tends to push it forward more and to strengthen the support, as indicated in Fig. 577. When the uterus is in retrodisplacement, its axis is directed toward the pelvic outlet, and the intra-abdominal pressure tends to push it down in that direction, as shown in Fig. 579. The continuance of this downward pressure, day by day, gradually
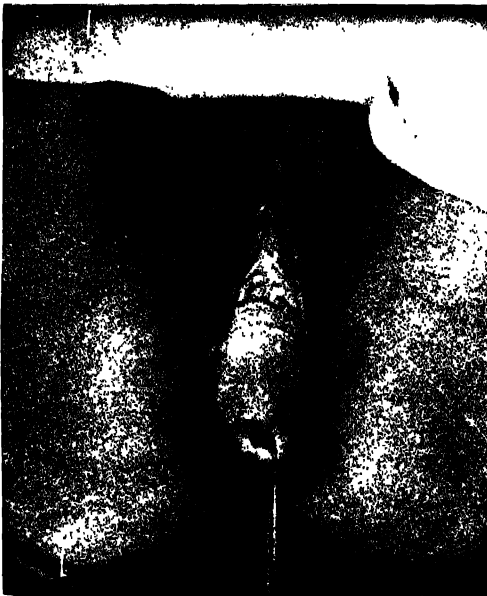
Fig. 581.   Fig. 582.

Fig. 581.—Prolapse of the uterus in a nullipara. (Hirst—*Diseases of Women.*)

Fig. 582.—Prolapse of the uterus in a virgin. (Küstner—*Kurzes Lehrbuch der Gynakologie.*)

stretches the supports, and the uterus and attached structures are pushed lower and lower, as shown in Fig. 580. Retrodisplacement not only disarranges the normal positional combination support but also places the uterus with the small end directed toward the outlet so that it becomes a wedge which will gradually dilate the lower part of the birth canal, even though it may have been repaired.

Prevention of prolapse consists of (a) repairing tears at delivery, (b) aiding normal involution by every means, and (c) correcting retrodisplacement if present.

A special type of case due to childbirth damage is that in which the prolapse comes on after the menopause, long past the time when trouble from birth injury is expected. This paradoxical happening is explained by the fact that after the menopause the atrophy of muscular tissue may so interfere with

the normal tone and fullness as to lead to the development of prolapse at that late age, the previous relaxation of the pelvic floor not having been sufficient in itself to cause it.

A third factor which appears in the origin of prolapse in some cases is **imperfect development** of the pelvic structures. In infancy the uterus extends upward in the direction of the vaginal axis and with the cervix in line. As development continues, the whole uterus comes forward, with the corpus more so. When development is imperfect, the infantile position may persist. As a cause of prolapse there are two items in this developmental defect. One is the retrodisplacement of the uterus, favoring prolapse as explained above, and the other is the tissue weakness characteristic of poorly developed structures. Lacking the tone and supporting strength of well-developed tissues, they gradually give way under the stress of adult activity and permit the uterus to prolapse. Remembering these facts, one will not be so astonished at encountering uterine prolapse in the nullipara (Fig. 581) or even in the virgin (Fig. 582). A point to be kept in mind in handling this type of case is that the pelvic tissues lack the normal strength and resistance, and when repaired in the usual way are very likely to stretch again with return of the prolapse. Consequently, care should be taken to employ measures which will give extra guard against recurrence.

Another point is that this defect may be associated with more extensive defective development, including spina bifida occulta. Laws has called attention to the role, often overlooked, of occult spina bifida and its accompanying weaknesses as a factor in bladder dysfunctions, uterine prolapse in nullipara, sphincter weakness, and regional nerve disturbances. He states that "the symptoms may be absent till adult life and then be considered as due entirely to injuries of childbirth," and again, "the vaginal plastic surgeon should think of occult spina bifida in terms of innervation of the skin, muscles, and connective tissue of the pelvic floor."

Pathology

In considering prolapse, it must be kept in mind that the uterus normally has considerable up and down movement. Respiration causes movement of the uterus, which is noticeable during the speculum examination, especially with the patient in the Sims posture.

There may be considerable exaggeration of the usual downward displacement without any symptoms, and that could hardly be called pathologic. The condition is not called prolapse unless there is marked downward displacement, and this is almost always accompanied with backward displacement of the uterus.

Prolapse is a progressive process, as indicated in Fig. 583. If the cervix is just appearing at the vaginal orifice, the condition is designated as prolapse of the FIRST DEGREE (Fig. 584). If the cervix protrudes from the vaginal orifice a considerable distance but not more than half of the uterus is outside, it is called the SECOND DEGREE (Fig. 585). If the larger part of the uterus lies outside the pelvis, it is called the THIRD DEGREE, or complete prolapse (Fig. 586).

In the usual case of prolapse, the uterus is found retrodisplaced and low in the pelvis, the pelvic floor is found lacerated and there is present more or
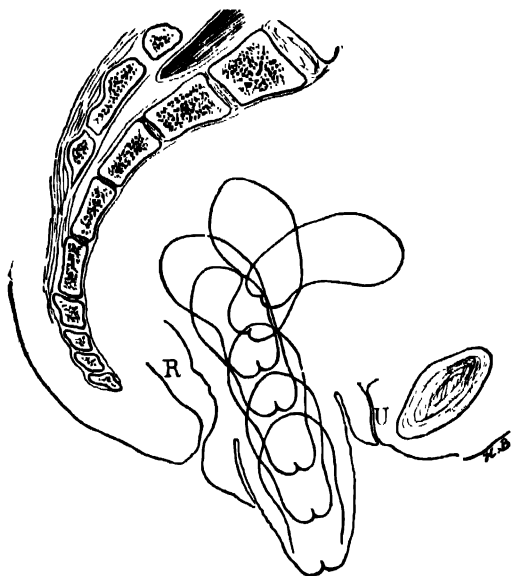
Fig. 583.

Fig. 584.

Fig. 583.—Prolapse of the uterus, showing the various steps in the process. (Kelly—*Operative Gynecology.*)

Fig. 584.—Prolapse of uterus—first degree, the cervix coming to the vaginal outlet. (Hirst—*Diseases of Women.*)
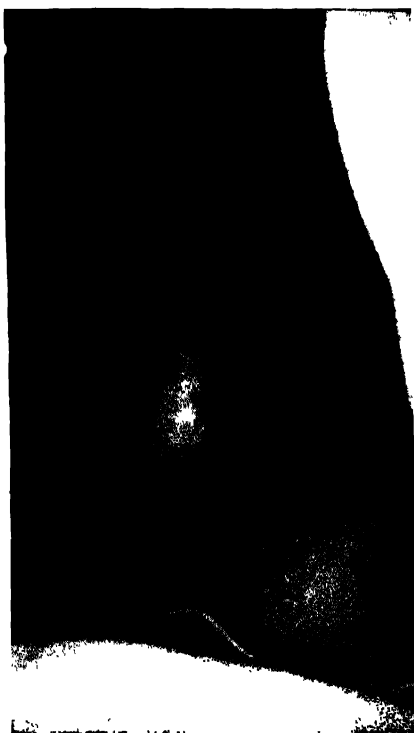
Fig. 585.

Fig. 586.

Fig. 585.—Prolapse of uterus—second degree, the uterus coming a considerable distance outside the body.

Fig. 586.—Prolapse of uterus—third degree, the entire uterus lying outside. (Hirst—*Diseases of Women.*)

less endometritis with discharge. The vaginal walls also are relaxed and thrown into folds by the position of the uterus, and may be found projecting outward at the vaginal opening, forming an anterior or posterior colpocele.

The projecting vaginal wall precedes the cervix on its downward journey. If the bladder follows the projecting vaginal wall, as it frequently does in severe prolapse, the condition is known as cystocele. In some cases of severe prolapse, the anterior rectal wall follows the projecting posterior vaginal wall, forming rectocele.

The cervix in many cases has been severely lacerated and is chronically inflamed and is the seat of cystic disease and of irritating discharge. In severe prolapse, ulcers often appear on the cervix or vaginal walls, being due to irritation of the clothing and to interference with the circulation of the prolapsed portion. The interference with the circulation may be due to two factors—constriction of the prolapsed portion by the vaginal opening and stretching of the uterine blood vessels with consequent diminution in their caliber. All the ligaments of the uterus are stretched until they give practically no support, and the lower pelvis is occupied by the intestines instead of by the pelvic organs, which are prolapsed outside. Sometimes coils of intestines may lie in the cul-de-sac behind the uterus, outside the vaginal opening.

Symptoms

The symptoms of prolapse of the uterus are dragging pains in the back and pelvis, worse when walking, some protrusion at the vulva, and sometimes difficulty in urinating. In some cases the protruding bladder must be pushed back into the pelvis before the patient can urinate. Even then there is more or less residual urine which is likely to lead to cystitis. Some patients complain of partial incontinence of urine when coughing or laughing. In exceptional cases, it is this partial incontinence that brings the patient to a physician, and he must recognize the cause or he will fail in the treatment.

Examination reveals as follows in the different degrees of prolapse:

First Degree.—The pelvic floor is relaxed and there is more or less protrusion of the vaginal walls. The uterus is usually retroverted and the cervix is low in the pelvis and far forward, near or at the vaginal opening (Fig. 584). Coughing or straining causes the cervix to sink lower and the vaginal walls to protrude more.

If there is still doubt as to whether the uterus sinks low enough to be called prolapse or to cause symptoms, the patient may be examined in the standing posture, but this is rarely necessary.

Second Degree.—The cervix is found protruding at the vulva and may be made to protrude more by bearing down (Fig. 585). There is also protrusion of the vaginal walls and sometimes of the bladder. Rectoabdominal examination (Fig. 587) shows the fundus uteri low in the pelvis.

The cervix and vaginal walls may return into the pelvis when the patient is lying down. There is more or less erosion about the cervix and sometimes ulceration.

Third Degree.—There is a mass nearly as large as the fist protruding from the vulva and lying between the thighs (Fig. 586). It is covered by

the turned-out vaginal wall which, from friction of the clothing, has become dry and hard, resembling ordinary epidermis. At the lower part of the mass is the cervix, which is represented by a hard nodule with an opening in the center and more or less erosion or ulceration about it. The appearance of the cervix depends upon how much laceration of the cervix there has been.

Grasping the mass and palpating it to determine its contents, there is found a hard elongated mass—extending upward from the cervix. Usually the size and shape of the uterus can be accurately made out. From the cervix there is more or less discharge which may be clear and glairy, resembling the white of an egg, or it may be mucopurulent.
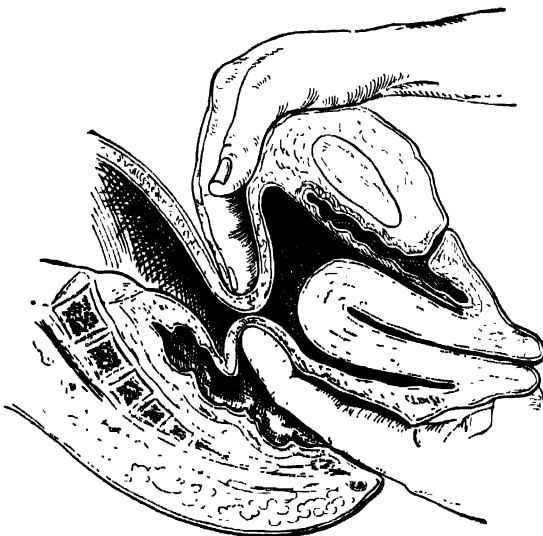
Fig. 587.

Fig. 588.

Fig. 587.—Determining the position of the body of the uterus by rectoabdominal palpation, in the differential diagnosis of prolapse from elongation of the cervix. (Ashton—*Practice of Gynecology*).
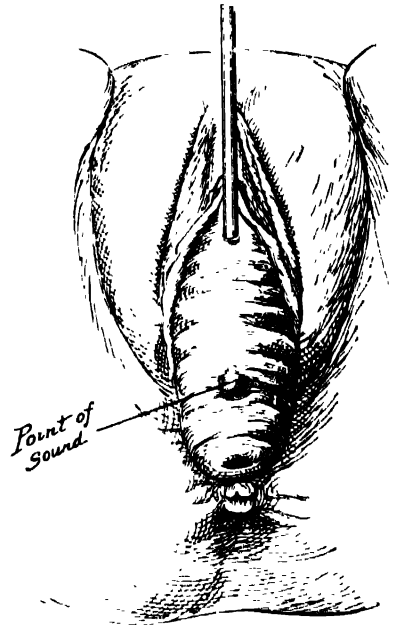
Fig. 588.—Testing position of bladder in a case of extensive prolapse, when the usual palpation of the mass still leaves the location of the bladder in doubt. (Ashton—*Practice of Gynecology*).

If the bladder has prolapsed also, it is felt as a thick cushion of soft tissue in front of the hard uterus. If there is a question as to the presence of bladder in the mass, a sound may be introduced to determine that point (Fig. 588), but it is better to avoid sounding the bladder unless there is strong reason for doing so, as it may introduce infection. The vaginal wall often presents spots of ulceration, especially about the cervix, and there may be much irritation over the whole mass and about the external genitals.

The residual urine and recurring attacks of cystitis and the dragging and narrowing and kinking of the ureters from the gradually increasing prolapse, eventually cause damage to the upper urinary tract.

The duration of the prolapse is a factor in the extent of damage—that is, all the time that a prolapse of considerable extent is allowed to continue without adequate support there is increasing damage to the ureters and kidneys. The

progress of such condition is so gradual that it may escape notice until brought to attention by infection in the damaged tract. In Fig. 589 is shown an autopsy specimen from a patient who came into the hospital with long-standing prolapse and uremia.

Investigators have listed various factors in such ureteral narrowing, such as, stretching and narrowing of the intramural portion of the ureter in the bladder prolapse, compression of the ureters outside the bladder by the con-

Fig. 589.—Autopsy specimen from a woman aged sixty-six years, who died of uremia. She had a prolapse of many years' standing, and careful dissection showed that on each side the constriction of the ureter caused hydroureter and hydronephrosis. The constriction was at the point where the uterine artery was dragged down over the ureter, as shown in the illustration.—(Wallingford—*Am. J. Obst. & Gynec.*)

stricting ring of the pelvic floor through which the mass prolapses, and constriction of the ureters by the overlying uterine arteries being pulled down over them. In the case shown in Fig. 589 the pressure of the dragged-down uterine arteries was apparently the particular factor in the ureteral stenosis, which led to the extensive double hydroureter and hydronephrosis. Infection entering the damaged tract completed the destruction of the kidneys.

Differential Diagnosis

Any swelling in the vagina or mass projecting outside may be mistaken for uterine prolapse, such as cystocele or rectocele or pedicled myoma, coming outside or still inside the vagina, or enlarged cervix or inverted uterus—all of which are shown in Figs. 590 to 595. Being rather unusual, the following conditions may cause an error in diagnosis:

1. **Hypertrophy of Cervix.**—In this condition (Fig. 594) the body of the uterus is felt nearly at its normal height in the pelvis. Also the depth of the uterus is increased, the amount of increase depending on the length of the hypertrophied cervix. Furthermore, the posterior vaginal wall is usually not pushed down, as it would be by a prolapse of the uterus, and the bladder is usually not involved in the projecting mass.
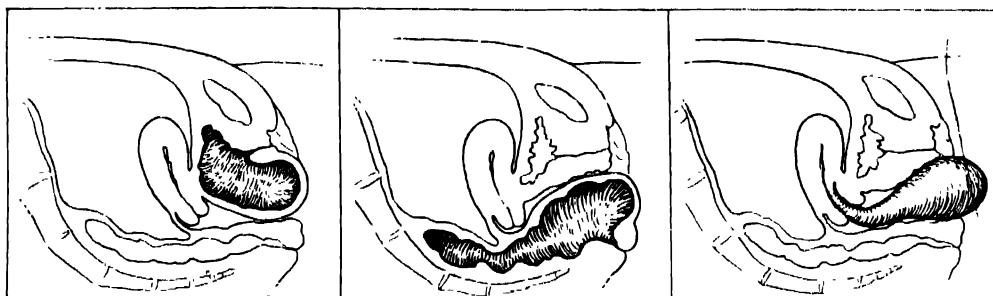
Fig. 590.　　　　　　Fig. 591.　　　　　　Fig. 592.

Figs. 590-592.—Differential diagnosis of prolapse of uterus. Other conditions that cause a projecting mass at the vaginal outlet, and which may be mistaken for uterine prolapse. Fig. 590, Cystocele. Fig. 591, Rectocele. Fig. 592, Projecting pediculated myoma.
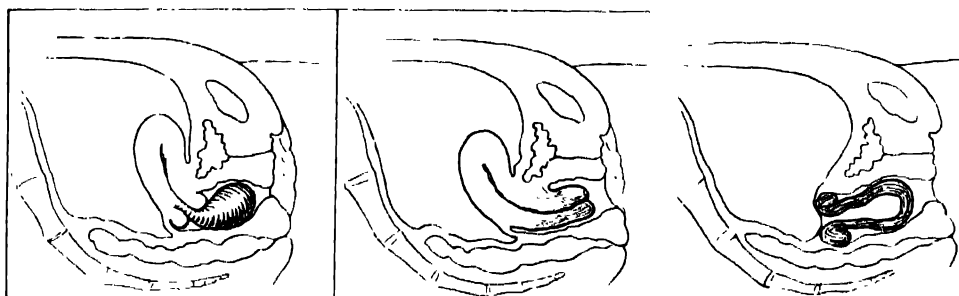
Fig. 593.　　　　　　Fig. 594.　　　　　　Fig. 595.

Figs. 593-595.—Differential diagnosis of prolapse of uterus. Other conditions that cause a mass low in the vagina. Fig. 593, Pediculated myoma from uterus. Fig. 594, Elongated cervix uteri. Fig. 595, Inverted uterus.

2. **Tumor or Cyst of Vagina.**—By careful digital examination, the cervix may be felt above the projecting mass and near its normal position.

3. **Tumors of Uterus, Projecting From Cervix.**—Such tumors are, of course, more or less pediculated and almost invariably they are fibroids. In such cases, there is felt near the vaginal entrance a mass, which may be hard or soft (Figs. 592, 593). If the mass is sloughing, part of it will be soft. No cervical opening can be felt in the mass and, by exploring higher around the mass, the cervical ring can be felt at the upper part of the vagina. If the tumor is sloughing, there is usually bleeding and a very offensive discharge. Furthermore, by bimanual examination, the body of the uterus may be felt near its normal position.

4. **Inversion of Uterus.**—In a case of inversion, a large mass, apparently a tumor, is felt in the vagina (Figs. 595, 607). The vaginal walls can be felt extending up past the mass. If it is sloughing, there will be bleeding and a foul discharge. Furthermore, the body of the uterus is not felt where it ought to be (Fig. 608, *A*). It is apparently nowhere in the pelvis, and by deep bimanual examination a depression may be felt with the abdominal hand at the upper end of the vagina—a cup-shaped depression with a hard margin, where the body of the uterus should be (Fig. 608, *B*). Inversion differs from a tumor in that a sound cannot be introduced far into the uterus, for the cavity is more or less obliterated.

Treatment

The means of treatment may be divided into two classes—palliative and curative.

PALLIATIVE MEASURES

The palliative measures after reduction of mass and treatment of irritation or ulceration are (1) pessary support, to keep the uterus and bladder within the pelvis, and (2) tampons and other palliative measures for conditions not suitable for pessary treatment.
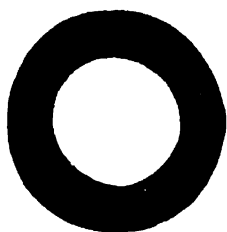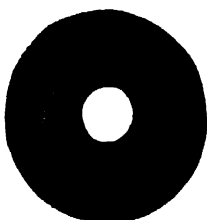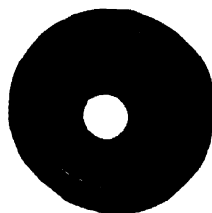
Fig. 596. Fig. 597. Fig. 598.

Figs 596-598.—Fig. 596, Flexible ring pessary. Fig. 597, Inflated ring pessary. Fig. 598, Hard rubber disk pessary.

1. **Pessaries.**—If there were no drawbacks to pessary treatment, its continued use in preference to operation might be advisable in those cases in which it gives subjective relief. But unfortunately there are drawbacks. Aside from the troublesome home care by the patient and the expense of necessary visits to the physician, there is the ever-present chronic vaginal and cervical irritation from the pessary. Much study has been given to the serious problem of eliminating this irritation, and considerable progress has been made. The most important thing is not the shape and materials of the pessary but the *removal* of it each night, thus relieving the pressure-irritation and permitting thorough cleansing of the vagina.

Ring Pessaries.—The ring or disk pessary (Figs. 596 to 598) is the simplest type of prolapse pessary. It is introduced edgewise and then turned so that the ring lies crosswise in the vagina. It is sufficient for some of the milder cases. If there is much relaxation of the pelvic floor, the ring tends to turn and slip out.

Menge Pessary.—The Menge pessary (Fig. 599) consists of a hard rubber ring with a detachable stem which prevents the ring from turning in the
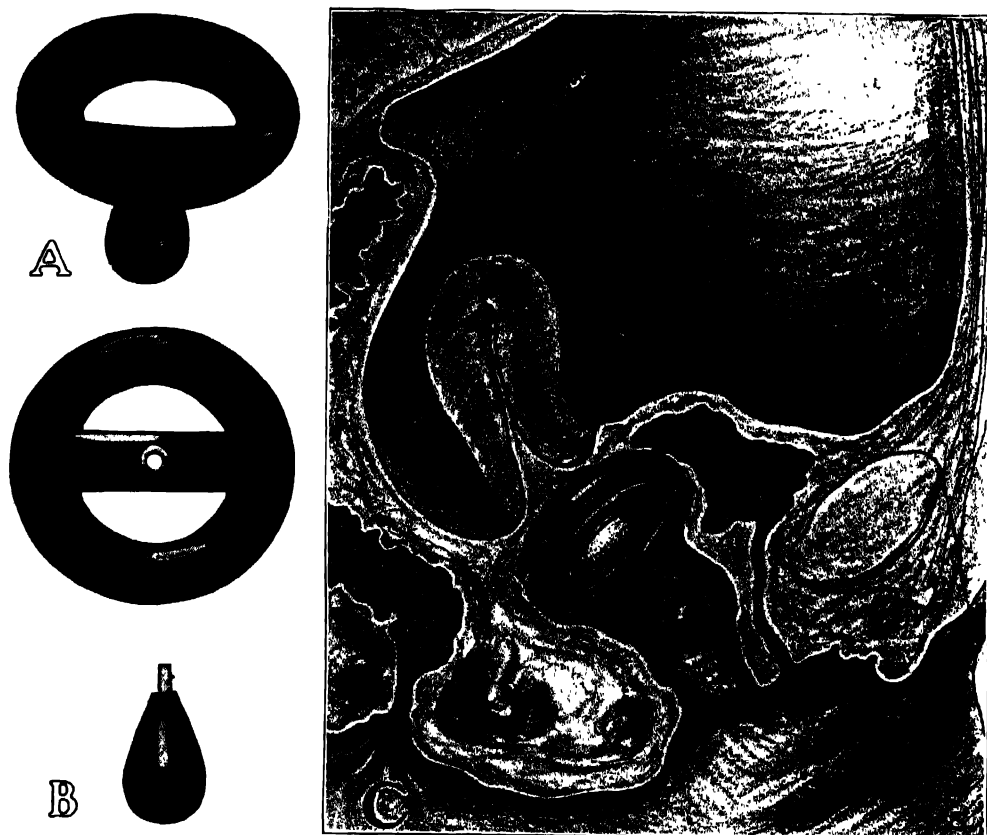
Fig. 599.—The Menge pessary. *A*, The pessary with the stem in place. *B*, The pessary with the stem detached from the ring portion of the pessary.

A.

B.

C.
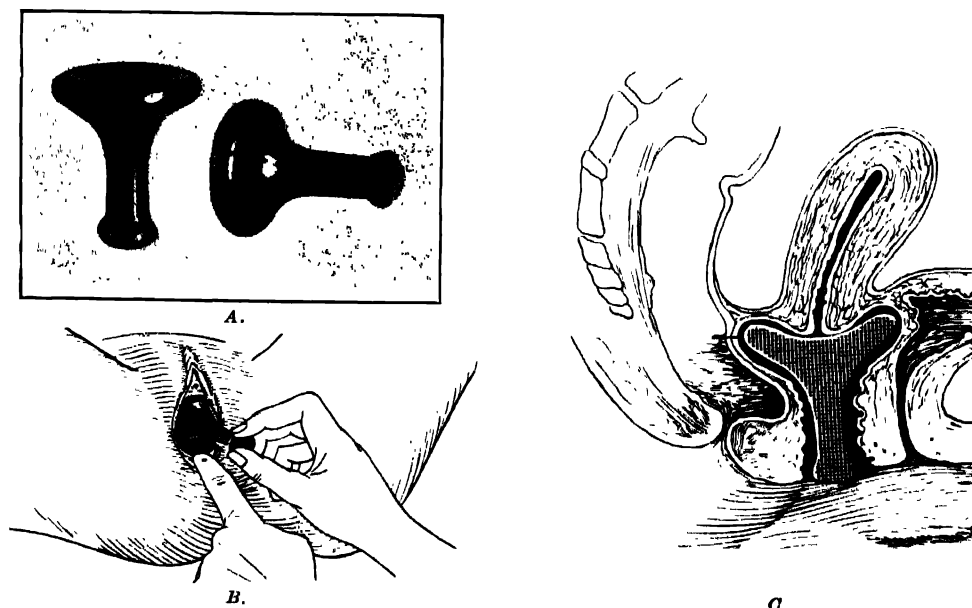
Fig. 600.—The Gellhorn pessary. *A*, General appearance. *B*, Introducing pessary. The perineum is to be strongly depressed. *C*, Pessary in place. (Gellhorn: *Am. J. Obst. & Gynec.*)

vagina. As ordinarily used (left in place continuously between office visits) the Menge pessary has the disadvantage that it blocks the vaginal canal, thus interfering with cleansing of the vagina and with coitus.

By attaching the stem before introduction and using a smaller size of pessary, it is possible to introduce and remove it as one piece; and by definite instruction some patients may be taught to do so. It is difficult, however, for the patient to remove this pessary, because the stem is short and rounded with no ridge or grasping surface. This disadvantage is overcome in the Gellhorn pessary.
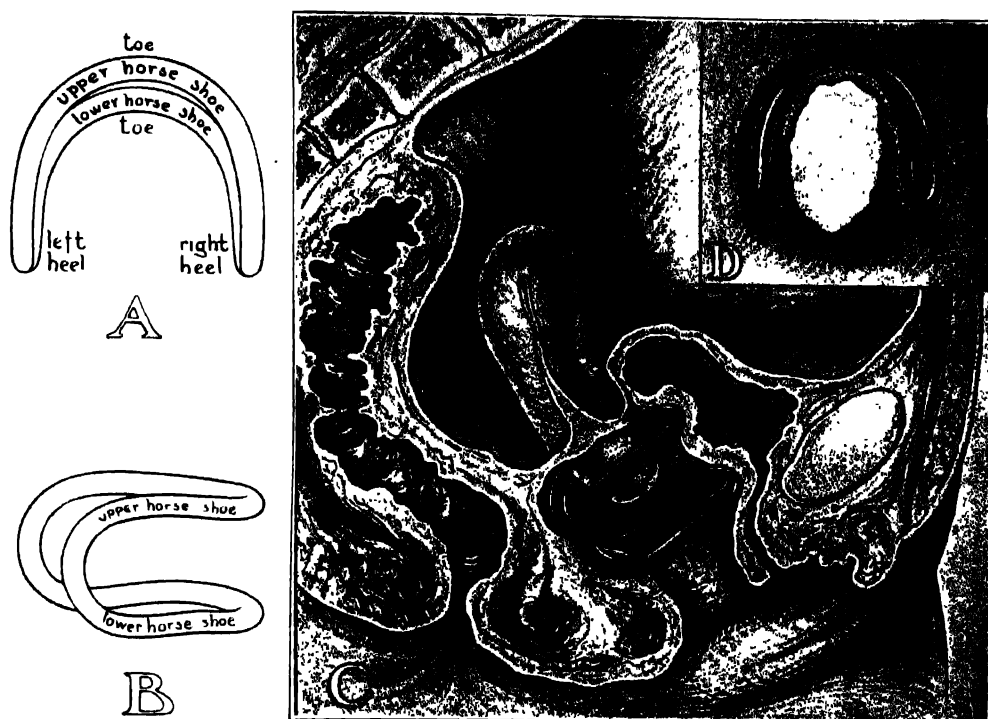
Fig. 601.—The Gehrung pessary. *A*, The pessary as viewed from above. *B*, The pessary as viewed from the side. *C*, The pessary in place, showing the action of the upper arch in holding up the uterus and base of the bladder. *D*, Showing how the heel on each side indents the tissues some distance from the vaginal opening, instead of pressing into the opening like a wedge, as do other pessaries.

Gellhorn Pessary.—This pessary (Fig. 600) has the supporting characteristics of the Menge type and yet is removable by the patient. The pessary is introduced as follows, quoting from Gellhorn's article.

"It is inserted, well lubricated, edgewise and in an oblique direction, so as to avoid the urethra, while the perineum is strongly pushed downward. It is introduced into the vagina by a corkscrew-like motion. Once within the vaginal lumen, the pessary is pushed upward until only the extremity of the stem shows in the vaginal entrance. The appliance then lies transversely beneath the cervix, as shown in Fig. 600, *C*. The patient removes the pessary every night by pulling on the handle of the stem, turning the latter to one side, and then reversing the steps of introduction. Straining downward will facilitate this procedure."

Gehrung Pessary.—In those cases of severe prolapse not amenable to the previously mentioned pessaries, particularly where the cystocele slips out beside them, the Gehrung pessary (Fig. 601) is very helpful. When properly placed, it usually gives effective support to the troublesome bladder and uterus, and yet does not interfere with vaginal-vault douching or with coitus. But it cannot be removed and replaced by the patient. In fact the manipulations of introduction are such as to require careful study and practice by the physician for his use of them.
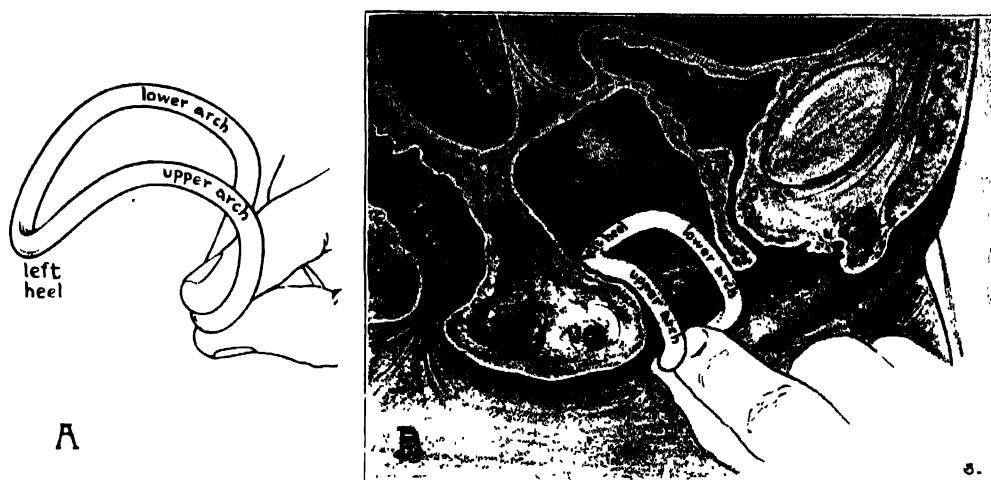
Fig. 602.—Introducing the Gehrung pessary. *A*, Showing how the pessary is held. *B*, First step in the introduction—see directions for introduction.
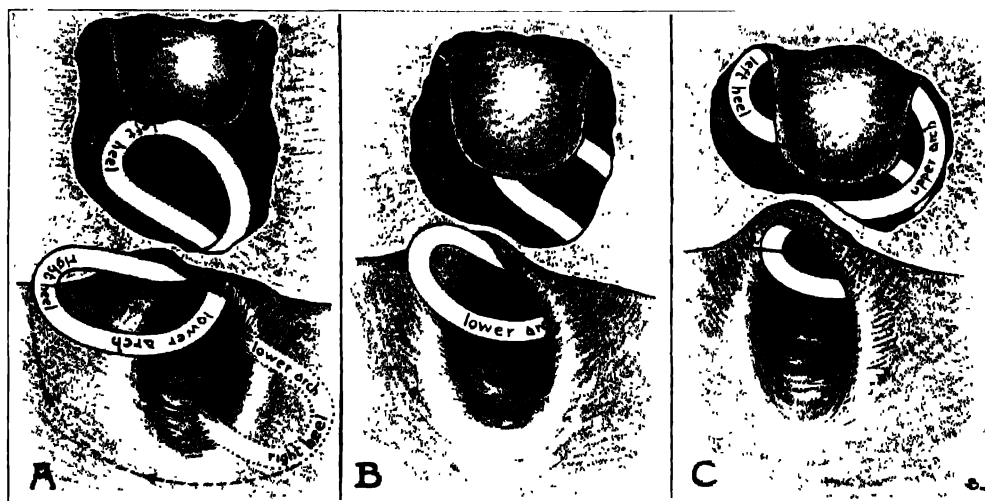
Fig. 603.—Introducing the Gehrung pessary. *A*, Swinging the right heel to the right side, which carries the left heel under the cervix to the left side and brings up the upper arch, which was below. *B*, Pushing the pessary around the vaginal wall back of the cervix, in order to get the right heel within the vagina. *C*, Further progress in the same direction.

The Gehrung pessary avoids the wedge-action by which other pessaries tend to dilate the vaginal opening, by pressing into the superior surface of the supporting shelf as shown in Fig. 601, *D*. This causes a depression on each side in which the pessary becomes "set" so that it does not slip around.

The introduction and satisfactory adjustment of the Gehrung pessary require considerable study and experience. In introducing the pessary the right heel is grasped in the fingers of the right hand, as shown in Fig. 602, A. The upper arch is below. With the right heel held to the left side of the vulva, the left heel of the pessary is pushed into the vaginal opening as far as it will go (Fig. 602, B). Then the right heel, still grasped in the fingers of the right hand, is swung across to the right side as indicated in Fig. 603, A. This brings uppermost the upper arch which was below, and causes the left heel of the
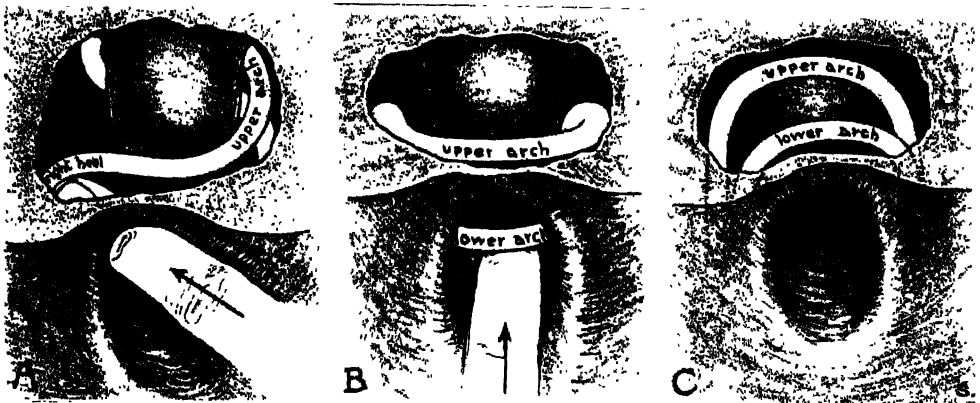
Fig. 604.—Introducing the Gehrung pessary. A, The right heel within the vagina and being carried to its position on the right side. B, The two heels situated symmetrically on each side. The arches are still too low. C, The arches pushed up into place back of the symphysis.
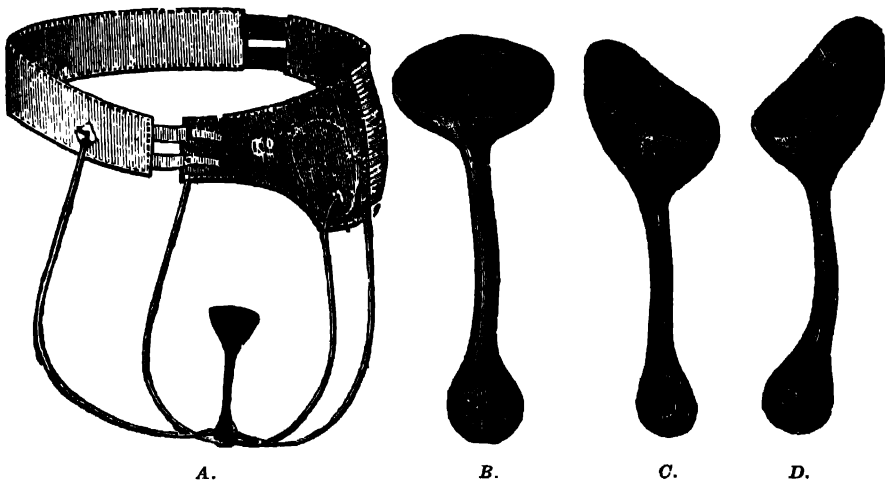
Fig. 605.—A, Cup and belt pessary. B, C, D, Different cups that may be used.

pessary to pass under the cervix (Fig. 603, A) to the patient's left side (Fig. 603, B). Now the pessary is pushed in farther, the left heel passing around behind the cervix far enough to permit the right heel to slip inside (Fig. 603, C). The right heel of the pessary is then pushed along the vaginal wall to the right side (Fig. 604, A), until the right and left heels are situated symmetrically on each side of the vaginal opening (Fig. 604, B). The next step is to push the pessary up (Fig. 604, B) until the lower arch lies above the vaginal opening and behind the urethra, and the upper arch supports the uterus and base of the

bladder (Fig. 604, *C*). This puts the supporting arches in the position shown in Fig. 601, *C*, and the heels of the pessary take hold at the sides of the vaginal opening as indicated in Fig. 601, *D*.

If the heels tend to slip around at first, a little tannic acid powder may be used on each side, to prevent slipping until the heels become set.

Cup and Belt Pessary.—This form of support consists of an abdominal belt to which are attached rubber cords which in turn hold in place a hard rubber stem and cup extending into the vagina (Fig. 605). It is an old form of pessary which sometimes gives much relief in extreme cases in which every

Fig. 606.
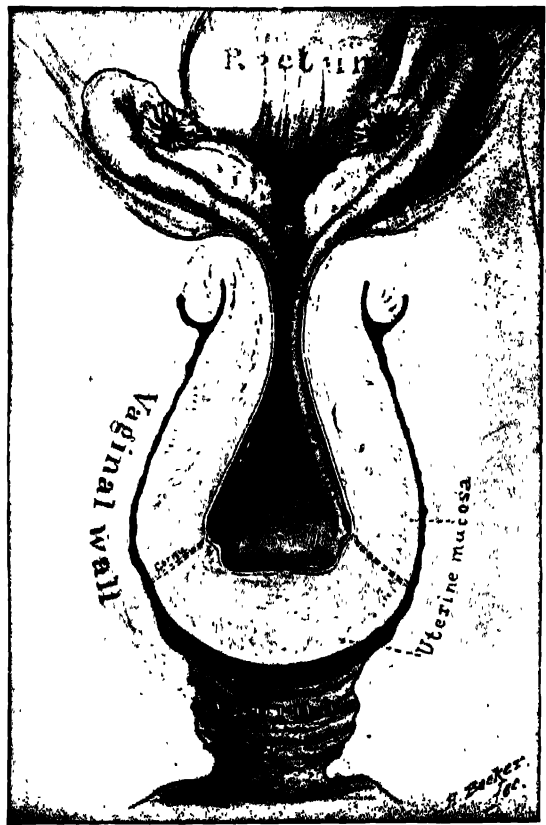
Fig. 607.

Fig. 606.—Complete inversion of the uterus, forming a large mass at the vulva. This is a postpartum inversion and the placenta is still attached to the turned-out fundus uteri. (After Bumm. Williams—*Obstetrics*, D. Appleton-Century Company.)

Fig. 607.—Inversion of the uterus, forming a mass in the vagina. (Kelly—*Operative Gynecology.*)

form of pessary depending on the pelvic floor for support slips right out. Of course this pessary, as well as other pessaries, is only a makeshift giving temporary relief, and curative operative procedures are indicated in suitable cases. But some of these women are not in physical condition for operation, while some others refuse operation, preferring to get along with a fairly satisfactory pessary. A modification sometimes useful is that form in which a ball is substituted for the cup at the top of the stem.

2. **Tampons, Rest in Bed, Astringent Douches.**—Where no form of pessary will hold the structures back, a firm vaginal packing of gauze or cotton tampons may be placed, preferably with the patient in the knee-chest posture or in Sims' posture. This packing will hold the uterus up temporarily and, by placing a pad over the vulva and holding it firmly in place by a strong T-bandage, the packing may be kept in place two days. This method is very useful when treating the ulceration often found about the cervix and also to give temporary relief while preparing the patient for operation.

If the patient can spare the time to go to bed and remain there a week or two, taking astringent douches when not packed, she will experience considerable relief from pain and discomfort. This is especially important when there is ulceration of the cervix or vagina requiring treatment.
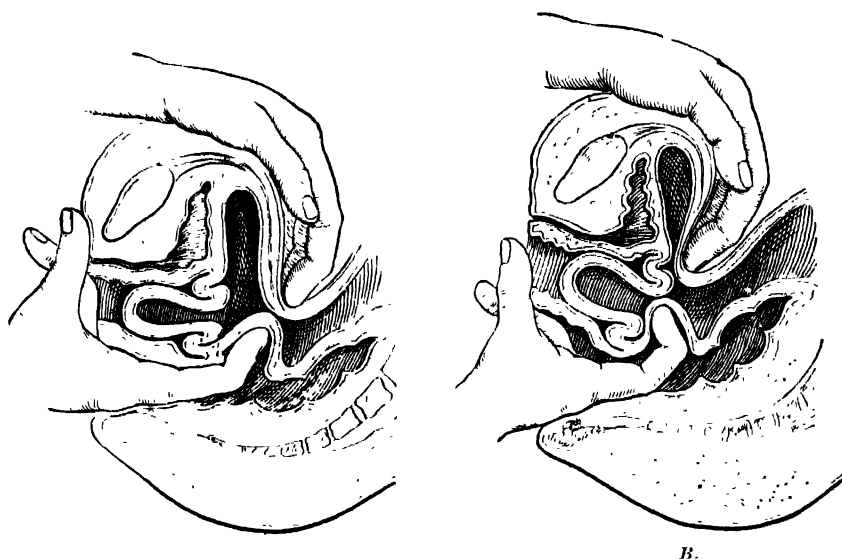
Fig. 608.– Diagnosis of inversion of the uterus. *A*, Determining the absence of the body of the uterus from the pelvic cavity. *B*, Determining the presence of a cupshaped depression above the cervix. (Ashton– *Practice of Gynecology.*)

CURATIVE MEASURES

These are all operative and may be divided into two classes: (a) those that preserve all the genital functions, and (b) those that do not.

Prolapse of the uterus and adjacent organs giving sufficient trouble to require operative treatment requires extensive work by an experienced surgeon, with careful adaptation of method to type of prolapse and complications. Much advance has been made in the operative handling of prolapse cases, and the various operations suitable for different types of cases and complications are considered in detail and freely illustrated in our Operative Gynecelogy.

As to indications for curative operation, it is important to keep in mind the danger of ureteral narrowing and back-pressure when second or third degree prolapse is allowed to continue unrelieved over a long period. The advance of minor prolapse to the more marked degree is so gradual and with so little acute disturbance that patients become accustomed and adjusted to it,

and sometimes prefer to go along with the annoyance rather than submit to operation or employ pessary treatment with sufficient consistency to keep the uterus in place.

In advising such a patient, the physician must give weight to the demonstrated tendency toward ureteral narrowing, with the gradual insidious development of hydroureter, hydronephrosis and damage to kidney function (Fig. 589). These facts emphasize two items concerning treatment in prolapse cases. First, prolapse of second or third degree requires treatment (operative or by pessary) which will keep the uterus and bladder in place and check the tendency to hydroureter and hydronephrosis, even though there is no severe subjective disturbance from the prolapse. Second, a patient coming for operation for prolapse should have preoperative investigation as to hydroureter and hydronephrosis, that precautions may be taken to meet existing handicaps in that direction.

INVERSION OF UTERUS

Inversion of the uterus (Figs. 606 to 608) is a serious and rare displacement which is nearly altogether an obstetric affection. It occurs only in the puerperal state, except when due to the dragging weight of a tumor. When due to a tumor it simply constitutes one of the pathologic conditions incident to the tumor and does not require separate consideration. When occurring with a tumor, it is usually with a submucous myoma, and the condition is described and illustrated with that subject in Chapter VIII. The puerperal type (Figs. 606, 607) constitutes a serious obstetric emergency, of which full description is given in obstetric textbooks.

INFLAMMATORY AND METABOLIC DISTURBANCES OF THE UTERUS

In addition to inflammation and new growths and displacements of the uterus there are certain organic changes due largely to disturbance in the metabolism of the organ—either from endocrine disorders, as in endometrial hyperplasia, or from defective circulation and allied conditions, as in subinvolution. For convenience, these disturbances of metabolism and the inflammatory disorders are grouped together in this chapter. Laceration of the cervix is placed here also, for its clinical significance, in regard to products or symptoms or need for treatment, is due largely to complicating inflammation. These conditions affecting the uterus will be presented in the following order:

In Cervix Uteri	In Corpus Uteri
Acute Cervicitis.	Hyperplasia of Endometrium and Polyp Formation.
Chronic Cervicitis (including erosion, eversion, laceration, cyst formation, leucoplakia, and sequelae of laceration).	Membranous Dysmenorrhea.
	Acute Endometritis.
	Chronic Endometritis.
Ulcer of Cervix (simple, chancroidal, syphilitic, tuberculous, etc.).	Chronic Metritis.
	Subinvolution.
	Hyperinvolution.
Polypi of Cervix.	Hypertrophy of Myometrium.
Hypertrophy of Cervix.	Senile Atresia of Uterine Canal.
	Tuberculosis.
	Syphilis.
	Echinococcus.

ACUTE CERVICITIS

Acute cervicitis is acute inflammation of the cervical mucosa and underlying tissue lying between the external and internal os. It is due to infection with ordinary pus germs or with the gonococcus. In gonorrheal vaginitis, the inflammation frequently extends into the cervix and may remain in check there for some time. If in a case of gonorrheal vaginitis applications are made within a healthy cervix, gonorrheal cervicitis is likely to result.

A common form of cervicitis due to ordinary pus bacteria is that found in lacerations of the cervix with everted mucosa, in which inflammation comes and goes owing to irritation of the turned-out mucosa by the vaginal bacteria. Streptococcic or staphylococcic infection of the cervix may follow labor or abortion, but in the acute stage it is usually overshadowed by the more serious inflammation in the body of the uterus, i.e., the septic metritis.

When there is pelvic congestion from any one of its various causes, there may be increased secretion of clear cervical mucus and some reddening about the external os. This is frequently designated cervicitis, but it is apparently a circulatory rather than a bacterial disturbance. This hypersecretion with some erosion comes not infrequently in virginal conditions, when the patient is generally atonic or there is occupational or postural or endocrine pelvic congestion. It is seen also in the newly married, when care must be exercised to avoid mistaking it for beginning gonorrheal infection.

Symptoms and Diagnosis

The principal symptom of acute cervicitis is increased discharge from the cervix, with the irritation resulting therefrom. The cervical secretion is tenacious and stringy and resembles the white of an egg except that it is less fluid and more jellylike. The normal cervical secretion is clear and alkaline in reaction. In gonorrheal cervicitis the free pus admixture causes the mucus to become an opaque yellow plug in the cervix, with the tenacious stringy qualities characteristic of cervical mucus. In inflammation due to other bacteria the pus admixture is usually less in amount. There is usually considerable erosion about the external os, from the irritating discharge. There are also hyperemia of the cervix and bleeding on slight manipulation. The patient has an uneasy sensation of weight and discomfort in the pelvis, though acute cervicitis alone rarely causes pain. If there is much pain, it is probably due to some other trouble, for which search should be made.

Acute cervicitis causes but little trouble in diagnosis. The irritating partially opaque mucous discharge from the external os shows that there is inflammation in the cervix. The absence of pain and of tenderness of the body of the uterus on bimanual examination, and the absence of other symptoms of endometritis indicate that the inflammation is confined to the cervix. Whether or not it is gonorrheal may be determined by looking for evidence of gonorrhea elsewhere (vagina, urethra, vulvovaginal glands) and by examining the discharge for gonococci.

Treatment

The objects of treatment in a case of acute cervicitis are (a) to prevent the inflammation from spreading to the body of the uterus and (b) to remove the irritating discharge and the consequent discomfort. These effects are best secured by prompt administration of sulfathiazole or other sulfonamide, to check the gonococcal process and eliminate it as soon as possible. Details are given under Gonorrhea in Chapter IV. As to local treatment, attainment of the objects mentioned is aided (1) by avoiding any treatment or instrumentation within the cervical canal, limiting all applications to relieving irritation of the vaginal walls, (2) by warm lactic acid douches once or twice daily to remove the accumulating irritating discharge from the vagina, and (3) by limiting activity, such as dancing or long walking or other unusual exertion. Occasional office application of some mild antiseptic to the irritated vaginal walls and cervix will aid in relieving the discomfort.

CHRONIC CERVICITIS

Including Erosion, Eversion, Laceration, Cyst Formation, Leucoplakia, and the Sequelae of Laceration

Chronic cervicitis is chronic inflammation of the tissues of the cervix. It usually starts in the lining mucosa, but has extended deeply into the surrounding tissues by the time it becomes chronic.

Chronic gonorrheal cervicitis and chronic septic cervicitis follow acute inflammation of like character, though in some cases the acute symptoms are so slight as to escape notice. Laceration of the cervix is a fruitful source of chronic cervicitis, opening up the cervical glands and lymph spaces to the infection.
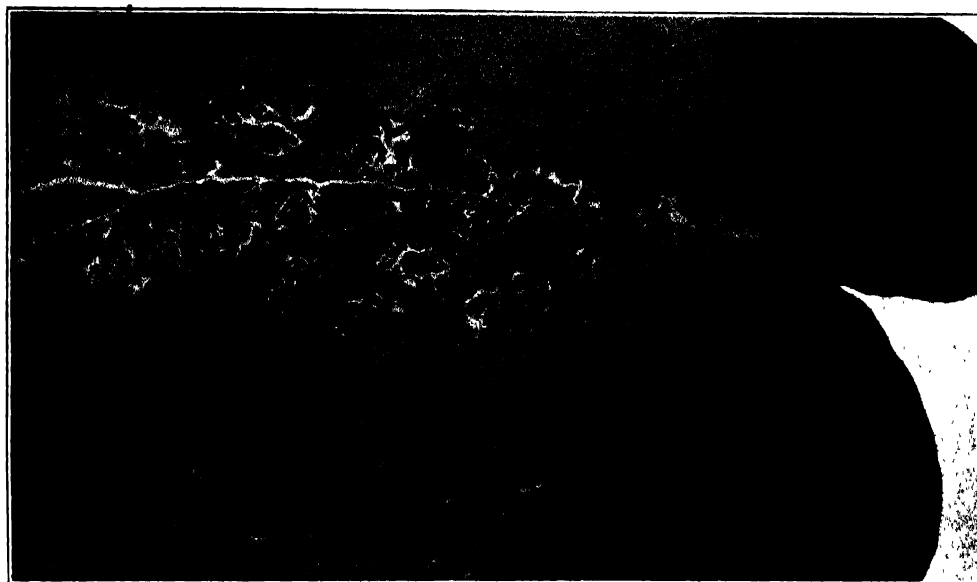
Fig. 609.—Cervicitis, chronic and localized to certain areas. This photomicrograph shows a considerable part of the cervical canal with its branching glands. The external os with its squamous epithelium is well shown. Notice that there are scattered inflammatory areas in the gland walls, both near the cervical canal and in the deeper portions of the glands. Each point of infection is surrounded by an area of round cell infiltration. This is brought out better in the high power (Fig. 610). Gyn. Lab.

Disturbance of the normal vaginal acidity is another possible etiologic factor in the complex condition. Roblee, who has made instructive studies of the pH variations in vaginal and cervical conditions, feels that faulty pH of the vaginal contents is an important factor, probably more important than the old infection, in keeping up and causing extension of cervical erosions and associated conditions, and hence that it must be considered in planning treatment.

Changes in Cervix

The infecting germs penetrate the mucosa and underlying structures, affecting the glands and interglandular tissue, as shown in Figs. 609 and 610. As the inflammation starts in the lining mucosa it is often referred to as "endocervicitis," but it quickly involves the underlying deeper tissues and

consequently the more comprehensive term "cervicitis" is better. There is increased secretion from the cervix and the clear cervical mucus becomes a mucopurulent discharge.

In the clinical picture of chronic cervicitis there are certain features which need individual attention. These features are erosion, eversion, laceration, cyst formation, and leucoplakia.

Erosion.—That phase of chronic cervicitis designated as "erosion" is very interesting in several directions. The term itself is rather confusing in that we ordinarily think of an eroded surface as one which has lost its epithelial
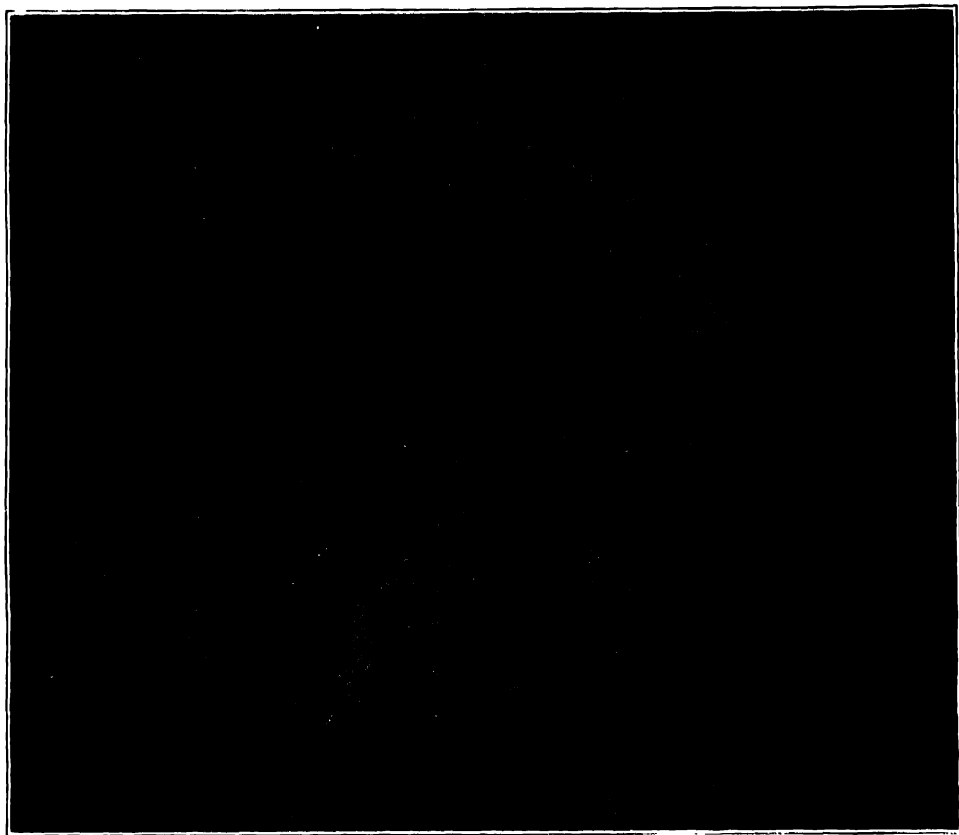
Fig. 610.—Cervicitis, chronic. This is a high power of a small area in the left half of Fig. 609, just below the cervical canal. The lumen of the canal is seen at the upper margin. A localized infected focus is seen in the right side, with some smaller foci in other parts. These two photomicrographs show clearly why applications in the cervical canal are of little avail in curing chronic cervicitis—the foci are outside the canal and inaccessible to such applications. Gyn. Lab.

covering, whereas when a microscopic section of an "erosion" of the cervix is examined it is found covered with columnar epithelium, which has replaced the pavement epithelium normal to that location.

Ries puts the matter thus, "The name is explained by the development of our knowledge of erosion. In the primitive period of gynecology, when the speculum furnished the closest means of study of the cervix, the early observers believed the red areas to be raw. The name 'erosion' expressed their concept of an area deprived of the normal surface layer. When Ruge, Veit, and later R. Meyer, studied the microscopic appearance of these areas it became evident that there was no denudation, but a change from the normal stratified

epithelium to the columnar type. The name 'erosion' was therefore corrected into pseudo-erosion, but the usage of decades has been to call the condition *erosion.*"

Erosion is started by irritation, usually from inflammation, and in its development there is a regular sequence of events which have been admirably described by Robert Meyer, Schottlander, Frankl, and others. To harmonize the name with the microscopic findings it has been assumed that, before the columnar epithelium grew out, the area must have been denuded of the squamous epithelium, leaving a real eroded area (the primary "erosion"), and that what we see in sections constitutes the various stages of healing. Meyer in his classical description adopts this view and designates the ordinary findings as "healing erosion," and gives an interesting description of the different stages of healing. We have followed this plan as a working basis, and steps in the progress of healing are clearly illustrated by photomicrographs from our departmental laboratory.

The difficulty about the unqualified acceptance of the idea of a primary denuded area of any considerable extent is that no one sees such a denuded area. Again, casting off of the pavement epithelium over the area in question and then covering of the denuded area by columnar epithelium is not the only way in which replacement of pavement epithelium by columnar could take place. It seems just as reasonable for the replacement of the pavement epithelium by the columnar to be simply a gradual pushing off of disintegrating pavement epithelium by the outgrowing columnar epithelium, without there being a real denuded area at any time.

The single-layered columnar epithelium covering the area permits the underlying vascular tissue to show through, giving a red appearance to the area. Fig. 611 is a diagrammatic representation of the microscopic details of the erosion area, the outlines of which as viewed through the speculum are shown in Fig. 612. At the middle of the upper margin of the microscopic diagram is the outer limit of the erosion. To the right is the many-layered squamous epithelium, which gives the pinkish-white color to the normal cervix, as shown in Fig. 613, *A*. To the left is the beginning of the erosion, which on inspection is red, as shown in Figs. 613, *B* and 613, *C*.

This condition represents the first step in repair; that is, in the area where the many-layered protective squamous epithelium is damaged and dying, the quick-growing columnar epithelium has taken its place as a temporary covering, to be replaced later by the slower-growing squamous epithelium which forms the permanent protection. This process of repair from start to complete healing goes through a regular sequence of events, which have been admirably described by Robert Meyer, Schottlander, Frankl, and others. For convenience in description this healing process is divided into three stages. It is important to know the general plan and details of these stages, for it is this knowledge which enables understanding of the complex and confusing microscopic pictures, some of which may be easily mistaken for carcinoma.

First Stage of Repair or Healing. The columnar epithelium quickly grows out over the denuded or eroded area. This covering of the denuded area by columnar epithelium is so rapid that a bare area is seldom seen. In fact, the two processes probably go on simultaneously, the columnar epithelium advancing little by little as the squamous epithelial covering disintegrates. There is dilatation of the capillaries and round cell infiltration of the underlying muscle and connective tissue.

The new layer of columnar epithelium covering the damaged surface proliferates so rapidly that it is thrown into minute folds, giving somewhat of a granulating appearance to the surface of the ordinary erosion (Fig. 613, *B*). In some cases these folds become high (Fig. 614), producing a velvety appearance like projecting granulations. This condition is designated "papillary erosion" (Fig. 613, *C*). In addition to covering the surface, the columnar epithelium tends to grow down into the underlying tissues and form "glands." If the openings of these temporary glands become obstructed small retention cysts are formed. Also, the projecting papillae may become adherent, thus blocking escape of the

secretion of the cells. A third factor in cyst formation, and probably the principal one in making the larger cysts, is the blocking of the regular glands of the cervix. When the cysts are numerous they form the "cystic erosion," as shown in Fig. 613, *D*. The cyst contents may be clear or may contain pus admixture, giving a yellow tinge as in the illustration. These little retention cysts of cervical glands were first described by Martin Naboth (about 1700) and are commonly called "nabothian cysts."
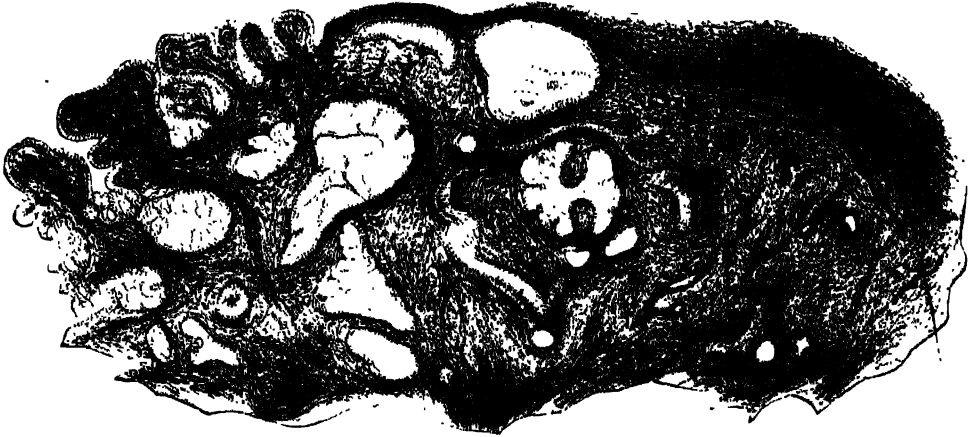
Fig. 611.—This historic diagrammatic section still serves well the purpose of calling attention to the essentials of an erosion of the cervix. At the right is the normal squamous epithelium covering the vaginal portion of the cervix. At the left is the area of erosion, showing the papillary projections covered with a single layer columnar epithelium. The cavities below the surface show the tendency to cyst formation. (A. Martin—*Atlas of Gynecology.*)
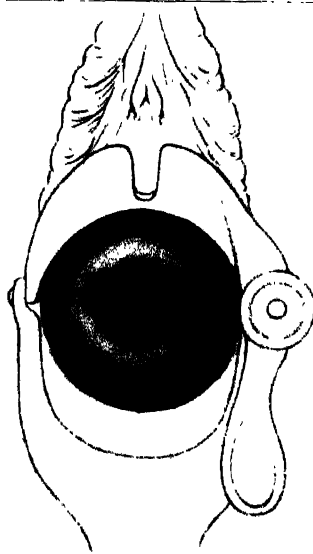
Fig. 612.—The usual appearance of an erosion on a multiparous cervix. The cervix is somewhat lacerated, and around the slightly everted cervical mucosa is the wide, irregular, red area of erosion.

Second Stage (Figs. 615 to 621). In the second stage of healing the squamous epithelium grows in from the edges, and from any remaining islands of squamous epithelium which were not cast off during the earliest stage. This epithelium grows under the columnar epithelium, displacing it. At the lumen of the glands it may dip in and displace the lining epithelium or it may seal off the lumen of the gland. If the latter occurs, the blocked glands may dilate beneath the squamous epithelium and form small cysts (nabothian

A.   B.
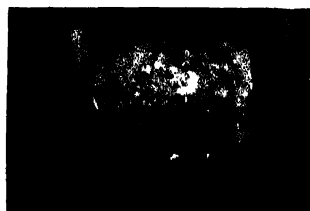
C.   D.

Fig. 613.- Colored photographs showing the characteristics of cervical erosions. *A*, appearance of the normal cervix; *B*, an extensive erosion; *C*, an erosion with definite papillary features; *D*, a cystic erosion, with pus in some of the cysts. (Baumrucker—By courtesy of Surgery, Gynecology and Obstetrics; Copyright, 1938, The Surgical Publishing Company of Chicago.)

Fig. 614.—Papillary erosion. An early stage showing all surfaces covered by columnar epithelium. At the bottom of the illustration is seen a small gland. Gyn. Lab.

Fig. 615.—Healing erosion. Very early second stage. In the right half of the photomicrograph is seen the area of erosion covered over by the single layered columnar epithelium from the cervical canal. Beneath this epithelium the round cell infiltration is still present. The squamous epithelium at the left is beginning to grow beneath the columnar epithelium. As this "creeping under" process proceeds, the columnar epithelium is raised from the surface and gradually disintegrates. Here the columnar epithelium may be seen in all stages of necrosis, from mere remnants near the top of the picture at left of center to the perfect columnar epithelium covering the site of the erosion. Gyn. Lab.

cysts), which contain clear mucus or opaque pus. These little cysts or abscesses may rupture through the surface, causing a repetition of the desquamation of the squamous epithelium.

Third Stage (Fig. 622). In the third or final stage of healing, the buried glands are taken over completely by the squamous epithelium, which continues to grow under the columnar epithelium, pushing off and disintegrating it. Spontaneous healing of the entire erosion is rare.

Coordinating Points. The healing process is not in the same stage in all parts of the cervix. Usually the various stages of healing can be seen by examining different areas of the same erosion. The picture may be extremely varied, with confusing intermingling of the two types of epithelium. A detailed study of the illustrative slides will make clear the salient features of erosion. The protecting squamous epithelium having been disintegrated by irritation, and the area quickly covered by outgrowth of the columnar epithelium, the regenerating squamous epithelium begins to regain the area by creeping under the tem-
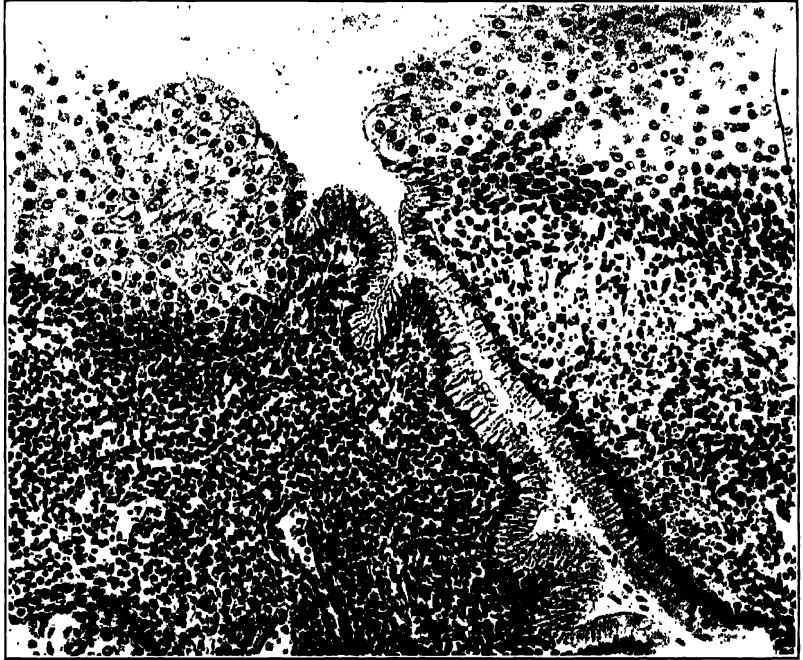
Fig. 616.—Healing erosion. The squamous epithelium has grown down from both sides and is seen here surrounding the duct of a gland. This gland is one of the many formed by the columnar epithelium which recently covered this area. From this point in the process of healing the squamous epithelium may do one of two things. It may grow across the opening leaving the gland beneath with no opening to the surface or it may encircle the gland, destroying the glandular epithelium and plugging the remaining space with squamous epithelium. If the former occurs, it is called the second stage of healing; if the latter occurs, it is designated as the third stage of healing. Notice the marked round cell infiltration in the underlying muscle. Gyn. Lab

porary columnar epithelial covering. The beginning of this process is well shown in Fig. 615. The various stages and ramifications of the interesting phenomenon of replacement of columnar epithelium by squamous epithelium in an erosion can be seen in this series of photomicrographs.

This creeping of squamous epithelium under the columnar epithelium, displacing the latter and filling in aberrant gland cavities with solid masses of pavement epithelium, gives rise to microscopic pictures which require great care to differentiate from the aberrant cell masses of carcinoma. The differential diagnosis is taken up under the Microscopic Diagnosis of Cervix Cancer,

There it will be noted also that this faculty of regenerating squamous epithelium to creep under and displace columnar epithelium is not always limited to an area of erosion but may extend into the cervical canal and involve normally placed glands, giving squamous-cell masses deep in the cervix. This "epidermization" of areas ordinarily occupied by columnar epithelium, follows, of course, the gland outline; i.e., one of the distinguishing characteristics is that it follows "the trellis work of the glands" instead of being the haphazard invasion of malignancy.
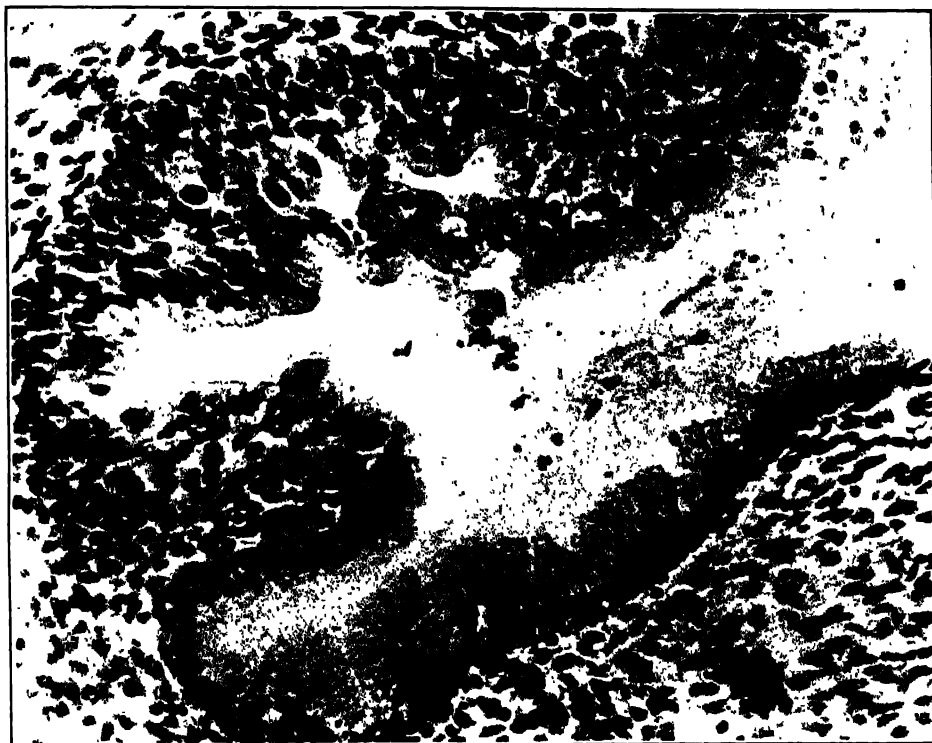
Fig. 617.—Healing erosion. The squamous epithelium is beginning to encircle the gland. The advance is along the upper wall, where it has lifted the columnar epithelium over a large area. Remnants of the latter may be seen along the upper surface of the cavity. The edge of the invading squamous epithelium is seen beneath the papilla at the left lower portion of the picture. The remaining intact columnar epithelium is seen on the lower wall of the gland. Gyn. Lab.

The question of metaplasia of columnar cells (or columnar-cell antecedents) to squamous cells enters some of these cases of extensive epidermization in the cervix. This origin is more evident, of course, in epidermization of the endometrium, mentioned in the Microscopic Diagnosis of Carcinoma of the Corpus. Novak in accounting for this squamous epithelium where only columnar epithelium should be states that we must consider three possibilities.

1. Direct extension of squamous epithelium from its normal situation (Meyer). This "creeping" tendency of squamous epithelium is clearly shown in our slides (Figs. 615 to 621) and is probably responsible for most of the epidermization seen in the cervix. It is possible for it to extend also to the endometrium, particularly if inflammation has prepared the way by damaging the intervening columnar epithelium.

2. Transformation or "metaplasia" of adult columnar epithelium into epithelium of the squamous type (Ruge).
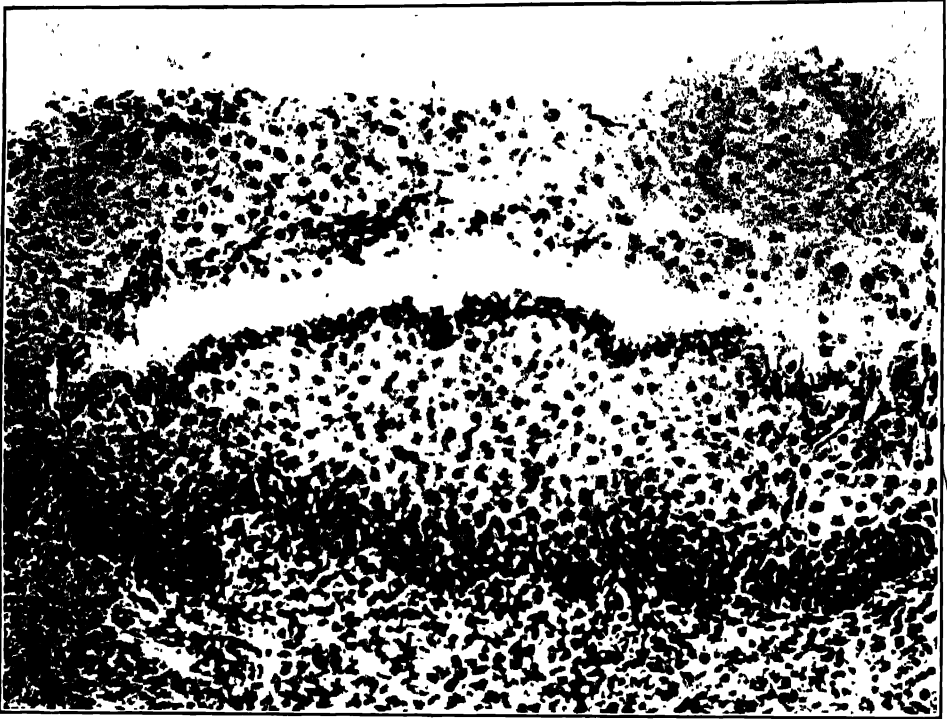
Fig. 618.—Healing erosion. In this section a superficial gland has been completely undermined by squamous epithelium and pushed out into the surface epithelium. It will soon be cast off with the superficial layer of the epithelium. Gyn. Lab.
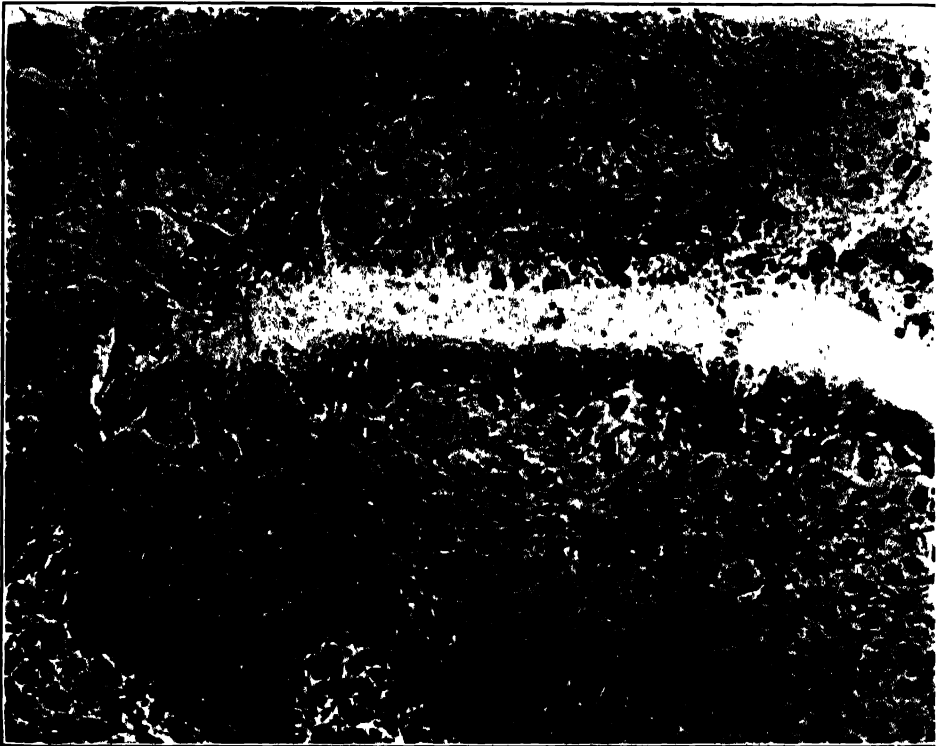
Fig. 619.—Healing erosion. High power of the gland shown in Fig. 618. Gyn. Lab.

3. Growth of squamous epithelium from embryonal rests of undeveloped cells (Meyer). These embryonal cells presumably retain the power to develop into squamous epithelium under proper stimulus. The extensive epidermization occasionally found in the endometrium is apparently due to embryonal rests or metaplasia.

A congenital type of erosion is described by Fischel, who states that it is found in 30 per cent of newborn infants. Frankl states that in the six-month
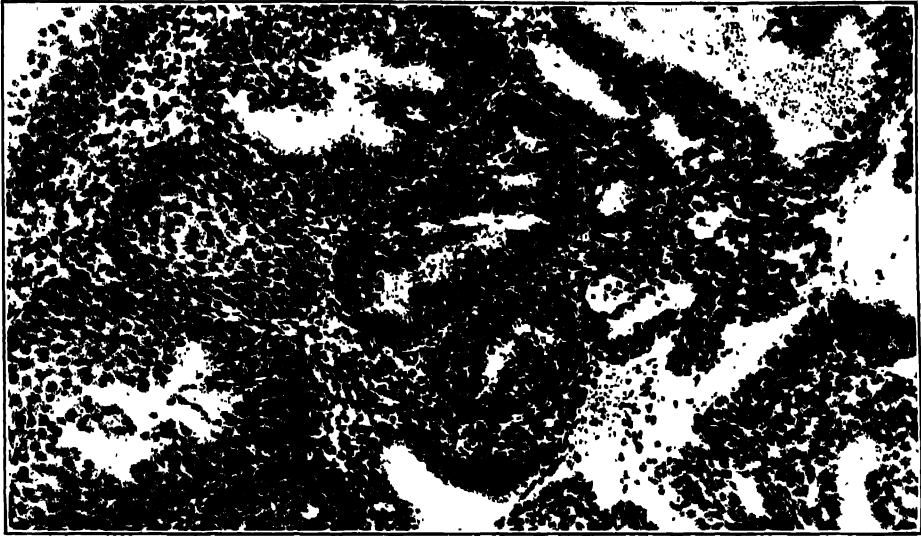
Fig. 620.—This shows various stages in the process of replacement of columnar epithelium by squamous epithelium as it encircles the gland and eventually plugs it. In the left half of the section there are three cavities, each showing a stage of the process. The upper cavity still has columnar epithelium on its lower border. In the lower cavity only remnants of the columnar epithelium remain. In the middle cavity the columnar epithelium has been eliminated and the cavity is completely filled with squamous epithelium. The cavity showing the intermediate stage is shown further magnified in Fig. 621. Gyn. Lab.
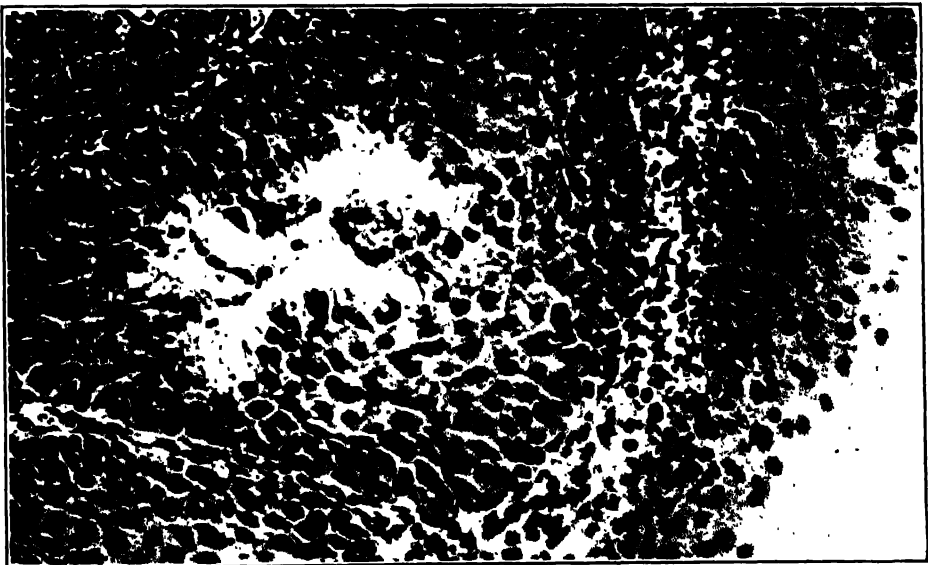
Fig. 621.—Healing erosion. High power of the cavity from the left lower corner of Fig. 620. This stage shows the intermediate stage in the process of replacing the columnar cell lining of the cavity by a solid mass of squamous epithelium. A few remnants of columnar epithelium may be seen in the débris at the center of the vanishing cavity. Gyn. Lab.

fetus the squamous epithelium covering the cervix extends into the cervical canal, but at the end of fetal life the junction of the two types of epithelium is usually in the neighborhood of the external os. If the columnar epithelium extends over the surface of the portio one speaks of it as a congenital pseudo-erosion. After birth there is, as a rule, a desquamation of the columnar epithelium, and the area is covered over by squamous epithelium from the border or from islands of squamous epithelium which have remained beneath the columnar epithelium.

There is an endocrine factor in erosions in the newborn and in children and in certain cases in adult life. Wollner was able to alter the histologic picture of atrophic cervices by administration of estrin and progestin. Estrin stimulated the proliferation of columnar cells, giving a picture of glandular hyperplasia with marked hyperemia and edema, such as is commonly seen in

Fig. 622.—Healing erosion, third stage. In this area, all of the columnar epithelium has been eliminated, and the depressions filled with squamous cells. There is still much round cell infiltration beneath the surface, and the epithelial covering is very thin in places. Gyn. Lab.

endocervicitis cases. Progestin, on the other hand, stimulated the growth of the squamous epithelium. With a combination of both hormones, the estrin seemed to accentuate the action of the progestin on the squamous epithelium, while the progestin inhibited the effect of the estrin on the columnar epithelium. These facts help to explain the occurrence of cervical erosion in the new-born, where there is unopposed action of the maternal estrin. Fischel found cervical erosion in 30 per cent of stillborn children, and Meyer in 33 per cent. Some of the erosions found in young girls where there is no evidence of infection can be explained on this endocrine basis, and treatment with progesterone should be tried before resorting to any severe local measures.

Eversion.—In chronic cervicitis, the inflammatory infiltration causes marked thickening of the mucosa and underlying tissues. As these tissues become more

and more thickened, they push out in the direction of least resistance, which is at the external os. This rolling-out (eversion) from inflammatory infiltration is most marked in the cervix which has been lacerated.

Eversion may occur also in a cervix where there has been no laceration, the rolling-out of the thickened mucosa with the consequent enlargement of the external os giving a very deceptive appearance of laceration (Fig. 630). This swelling and eversion from chronic inflammation may take place in the unmarried, and may become so marked as to give rise to an erroneous diagnosis of previous pregnancy.

Laceration.—Troublesome symptoms from cervix laceration and conditions requiring treatment are due largely to complicating inflammation. The changes brought about by inflammation in a lacerated cervix are progressive, and this progressive character with its underlying causes must be understood in order to recognize the various stages of the process as encountered in clinical work. To elucidate this matter let us follow through what may happen in a case of moderately deep laceration of the cervix, as represented by Fig. 623, *A*.

If there is no complicating inflammation of the torn surfaces, they may fall together and unite, leaving only a small notch as in Fig. 623, *B*. If they fail to unite, they may heal over by granulation and scarring, leaving two thin lips without special irritation or other disturbance (Fig. 623, *C*). In either case the condition causes no trouble and requires no treatment.

If inflammation supervenes, there follow an interesting series of progressive changes, leading to the various conditions seen in the later examination of such patients. As the inflammation penetrates into the cervix, the resulting infiltration causes marked swelling. This enlargement of the deeper tissues causes expansion in the direction of least resistance, which is inward toward the canal. The firm muscular wall of the cervix prevents expansion outward and prevents much lengthening of its outer portion. Consequently, as the increasing tissue accumulates in the inner portion of the damaged cervix, it tends to push apart the lips and roll out at the opening, causing eversion as indicated in Fig. 624, *A*.

This exposure of the endocervix to the vaginal bacteria and irritation increases the infiltration and eversion. The result is a progressive widening of the cervix and rolling-out of its inner portion, as shown in Fig. 624, *B*.

This process may keep on until the cervix becomes shaped like a ball, as shown in Fig. 624, *C*. This ball-shaped appearance is quite deceptive, as there is no notch to indicate the former deep laceration, and it may cause confusion in diagnosis unless the process of its development is understood. The clinical appearance of moderate eversion is shown in Fig. 625, and marked eversion to the ball-shaped stage in Fig. 626. Other cervices with laceration and chronic cervicitis are shown in Figs. 627 to 629.

A congenital split resembling a lateral laceration of the cervix has been observed in the newborn infant in a few instances. This congenital notch is of little importance, except that when seen in the adult it may lead to an erroneous diagnosis of previous pregnancy. A distinct laceration of the cervix is one of the strongest proofs of previous pregnancy, and the fact that a congenital notch somewhat resembling a laceration may occur is of medicolegal importance. Also, it must be kept in mind as above mentioned that chronic cervicitis may produce a condition of eversion resembling laceration (Fig. 630).
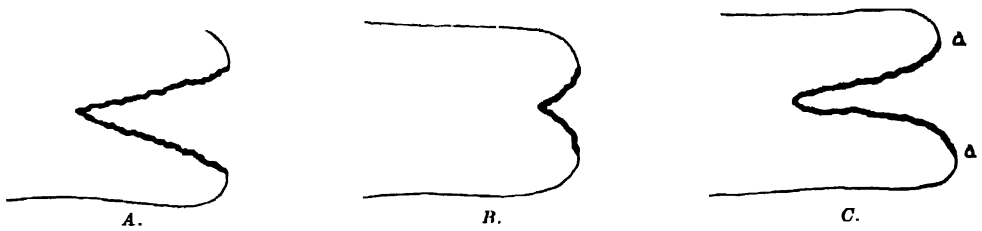
Fig. 623.—Illustrating different conditions in laceration of the cervix. *A*, Fresh laceration with the unchanged lips separated. *B*, Practically healed laceration of cervix, only a small notch remaining. *C*, Deep notch with two lips remaining, but the lips are not thickened. Such a cervix rarely causes trouble or requires repair.
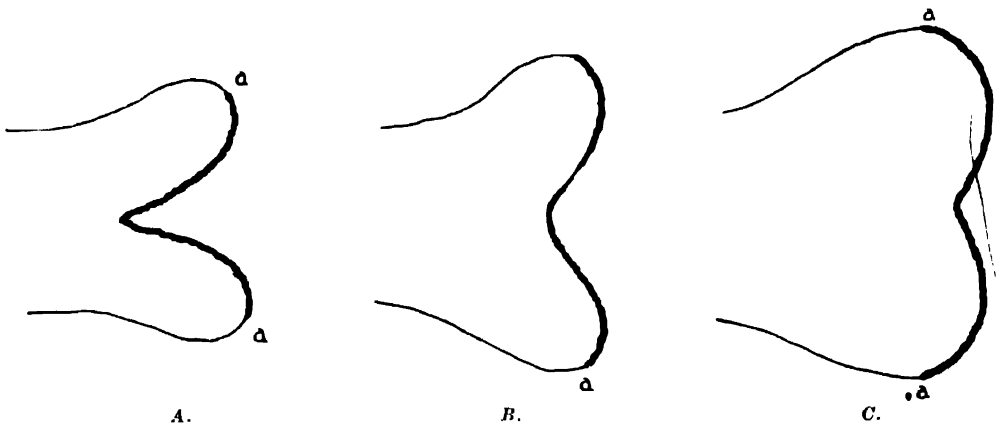
Fig. 624.—Different conditions in laceration of the cervix. *A*, Deep notch with thickened lips and beginning eversion. *B*, More thickening of lips and marked eversion. *C*, Marked infiltration and thickening of lips with complete eversion, forming the "ball-shaped" cervix shown in Fig. 626.
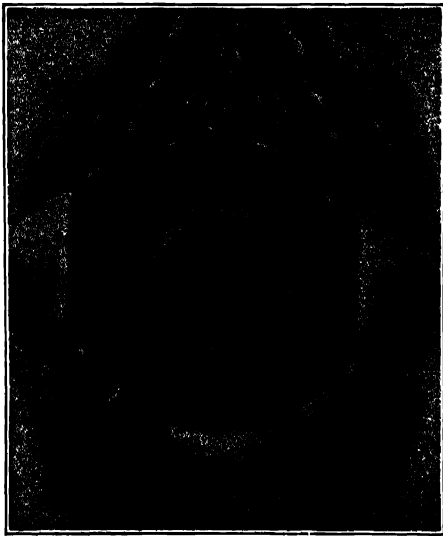
Fig. 625.

Fig. 626.

Fig. 625.—Moderate eversion and erosion in a cervix from chronic cervicitis. There is present also the usual stringy discharge.

Fig. 626.—A lacerated cervix in which there is so much eversion that the cervix appears as a round ball. (Kelly—*Operative Gynecology.*)

Cyst Formation.—The formation of small retention cysts in the cervix is due to obstruction of the ducts of normally situated glands by inflammatory infiltration and to the formation of glandlike cavities in areas of erosion as already explained. If there has been a laceration of the cervix, the resulting scar tissue may obstruct ducts and thus aid in cyst formation.
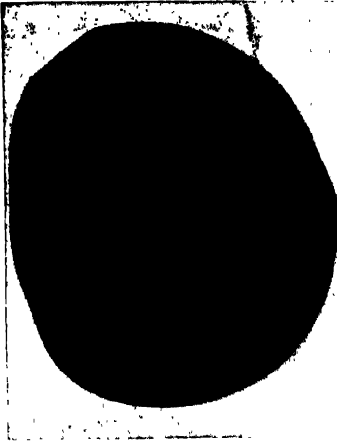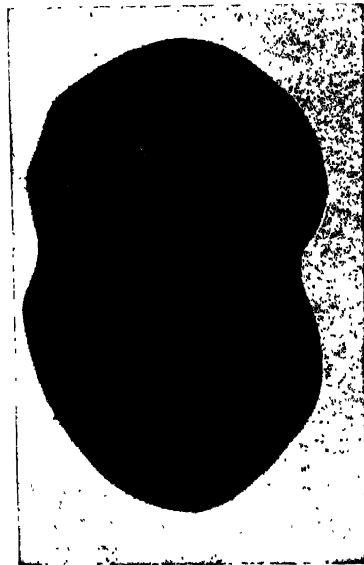
Fig. 627.   Fig. 628.

Figs. 627 and 628.—Bilateral lacerations of cervix. Fig. 627 shows marked bilateral laceration, with distinct lips rolled out. Fig. 628 shows an unusually deep bilateral laceration extending to the vaginal vault. (Mann—*American System of Gynecology*.)
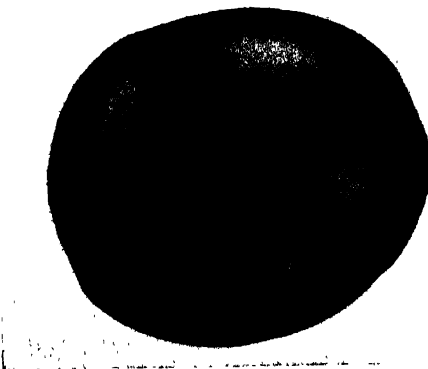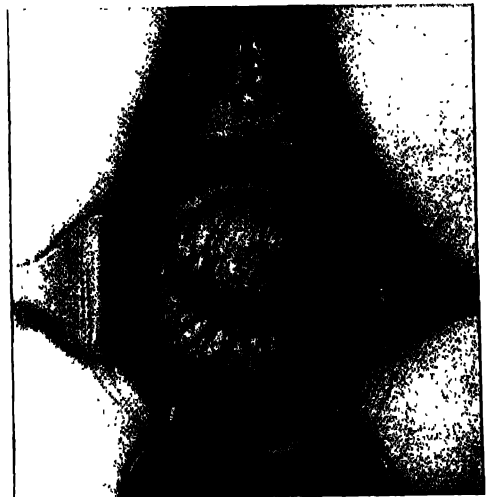
Fig. 629.   Fig. 630.

Fig. 629.—Deep stellate laceration of the cervix, with resulting thickening and eversion. (Mann—*American System of Gynecology*.)

Fig. 630.—Marked eversion from chronic cervicitis. There is no laceration of the cervix, the patient being a nullipara. (Cullen—*Cancer of the Uterus*, W. B. Saunders Company.) This eversion of the cervical mucosa by inflammation only, without previous laceration, is likely to lead to a mistaken diagnosis of laceration of the cervix. It is also of medicolegal importance, as the appearance of laceration may lead to the erroneous conclusion that the patient has at some time given birth to a child.

These retention cysts are felt as small hard nodules, like shot of various sizes, in the cervix, and may give rise to an erroneous diagnosis of cancer. The cervix may be honeycombed with these small cysts, producing a condition designated as "cystic degeneration" of the cervix (Figs. 631, 632). The mucus in these cysts is usually clear and presents the characteristic tenacious, stringy consistency. In some cases a cyst may contain pus and appear as a yellow spot (Fig. 613, *D*).
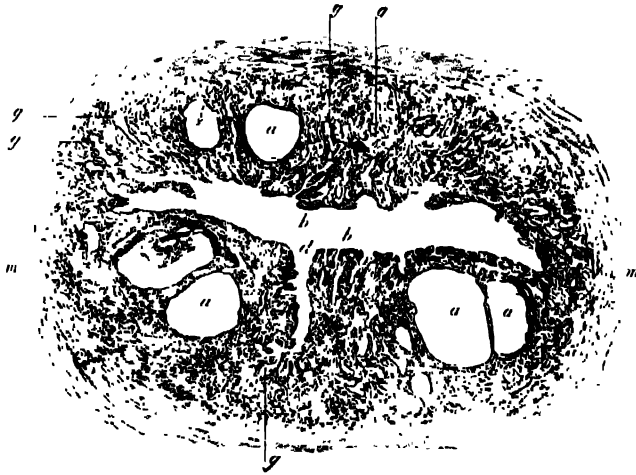
Fig. 631.—Cross-section of a cervix which is the seat of "cystic degeneration." *a*, dilated gland-cavities, forming small cysts; *b*, the cervical canal. (Pryor, after Cornil—*Pelvic Inflammation.*)

Fig. 632.—Section of cystic cervix. Notice how the dilated glands extend out under the squamous epithelial layer. Gyn. Lab.

Leucoplakia.—Leucoplakia is the term applied to certain small white areas occasionally seen on the cervix. They are smooth and there may be several, differing in size and shape (Fig. 633).

Although leucoplakia of the cervix was clearly described as early as 1896, very little was done to emphasize its importance until Hinselmann reported a

study of a series of cases by the aid of a colposcope. Since that time the importance of this condition is gradually being realized.

As seen through the speculum leucoplakia appears as a small, smooth, white area on the surface of the cervix. It may be single or multiple. It may be wiped off but returns within two or three days. Occasionally there is a halo of fine vessels around the area. After the area is removed, it loses its whitish appearance and is indistinguishable from the surrounding cervical tissue. Hence
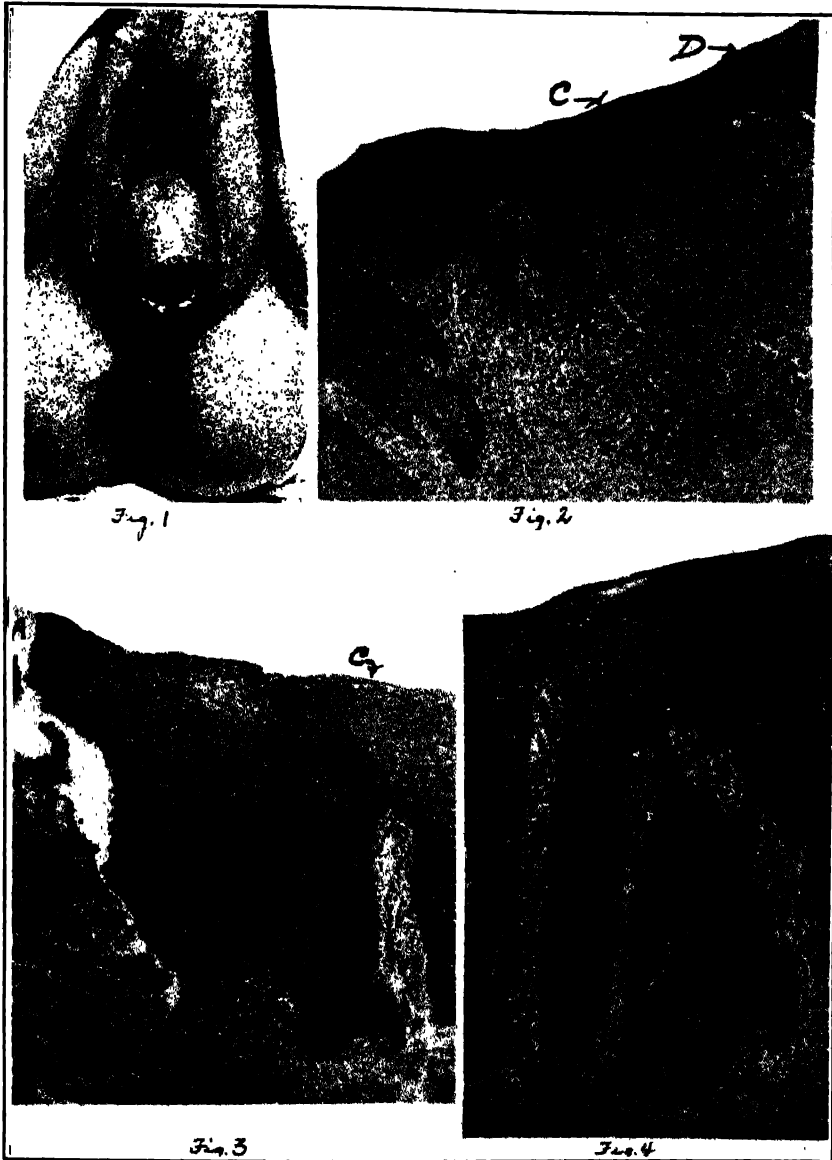
Fig. 633.—Leucoplakia of the cervix. *1*, Prolapsed cervix and uterus, showing dark area of erosion and whitish collar of leucoplakia in the cervix. *2*, Leucoplakic area, showing diffuse round cell infiltration (*B*) at the margin and beneath irregular rete malpighii pegs (*A*). Latter are bizarre and atypical. Cornification present (*C*). Sudden transition to more normal epithelium at (*D*). *3*, A break in the epithelium due to ulceration (*A*); round cell infiltration beneath and between rete pegs (*B*). Stratified squamous epithelium greatly thickened, cornified epithelium covering the surface (*C*). *4*, Irregular and bizarre rete pegs which are atypical, having precancerous appearance. Round cell infiltration between and within rete pegs. (Kretchmer—*Am. J. Obst. and Gynec.*)

the advice of Ries, that when a cervical specimen containing a leucoplakic spot is excised for examination, the spot should be marked by a small identifying suture on each side, otherwise it cannot be found in the laboratory.

The pathologic changes in leucoplakia of the cervix are: (1) hyperplasia of the epithelial prolongations, (2) changes in the cells of the epithelial layer, and (3) round cell infiltration in the underlying tissue.

1. Hyperplasia of the projections normally found at the junction of the epithelium with the underlying tissue is seen early in leucoplakia and is characteristic of the "hyperplastic stage." The prolongations become greatly enlarged and irregular, as shown in Fig. 633, though the surface may remain

Fig. 634.—Leucoplakia of the cervix. A somewhat later stage. Note the cervical glands. Gyn. Lab.

flat. In the atrophic stage, which comes later, the epithelial layer atrophies along with the marked changes in the subcutaneous tissue, as shown in Figs. 634 and 635.

2. The changes in the cells of the epithelial layer are described by Ries as follows:

The cells of the leucoplakia are packed densely, they take deeper stain in their protoplasm and in their nuclei, they are more irregularly arranged than in the normal stratified epithelium. Their basal layer is different from the normal basal layer in shape and staining quality. Protoplasmic bridges between the cells of the malpighian layer are less frequent and less pronounced. At the border of the leucoplakia there is a complete change which surprises the observer by its abruptness in a sharp, usually vertical, line extending

from the base to the surface (Fig. 636). In the leucoplakia the very last basal cell toward the normal tissue produces a totally different generation of cells from those starting out from the first and all other basal layer cells of the normal epithelium.

These cell changes are shown in Figs. 635 to 639, and also in other photomicrographs given later under the Differential Diagnosis of Cancer of the Cervix. A characteristic junction line where a leucoplakic epithelium meets the normal epithelium is shown in Fig. 636. The cell changes of leucoplakia of the cervix correspond very well with the cell changes found in leucoplakia of the external genitals (leucoplakic vulvitis), shown in detail in Figs. 354 to 359.

Many cases of leucoplakia of the cervix develop cell changes which are very erratic—so much so that they raise the question of beginning cancer.
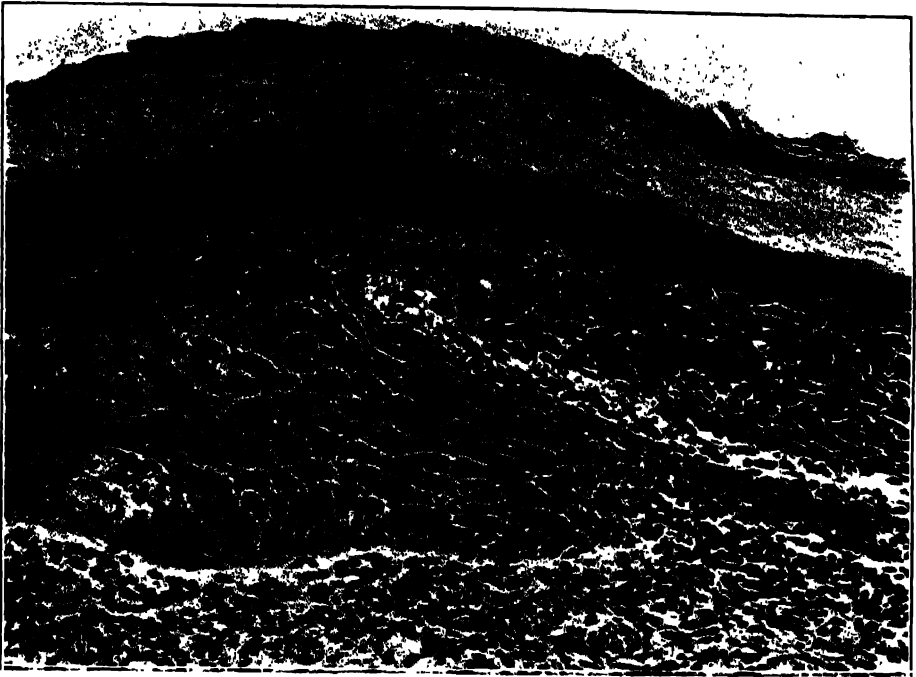
Fig. 635.—Leucoplakia of the cervix. High power of Fig. 634. Note the similarity of this to leucoplakia of the vulva (Fig. 358). At the top is the hyperkeratinization, beneath this is the dark layer made up of eleidin cells. A marked round cell infiltration is seen beneath the flattened prolongation of epithelium. Gyn. Lab.

Martzloff states, "The epithelial changes in some leucoplakic plaques have all the cytologic characteristics of cancer but lack the attribute of invasion." He presents Figs. 637 to 639, to show the cell changes referred to, Fig. 640 being given for comparison with the epithelium of normal repair in chronic cervicitis and erosion.

In regard to tendency toward malignancy, some workers claim that leucoplakia of the cervix is not a precancerous lesion. But Hinselmann states that all leucoplakias observed for a long enough time have become malignant, and he cites six cases. As mentioned above, Martzloff states leucoplakia may present all the cytologic characteristics of malignancy, but makes the point that technically an epithelium with such changes cannot be positively designated

as cancerous until there is invasion, as there is always the possibility that the
erratic cell activity may stop short of this last and decisive attribute of
malignancy.
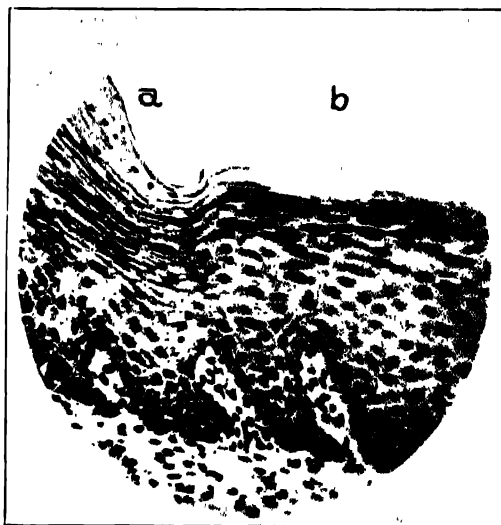
Fig. 636.—Photomicrograph of margin of leucoplakia. Under *a* the epithelium appears
essentially normal and shows various cell layers. Note sudden transition to *b* which represents
the leucoplakia. Here cells are compact, spinal cell layer is not discernible and the dark ap-
pearing cells near the surface represent a stratum granulosum. (Martzloff after Esser—*Am. J.
Obst. and Gynec.*)
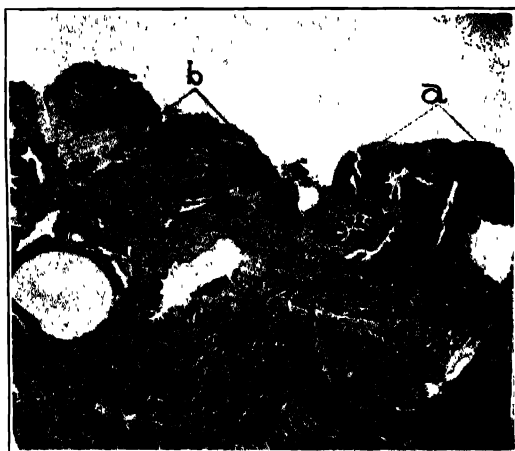
Fig. 637.
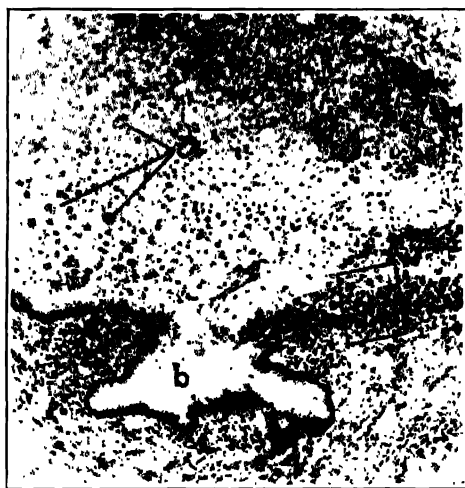
Fig. 638.

Fig. 637.—Leucoplakia. At *a* is essentially normal cervical epithelium with some under-
lying glands. The depression between areas *a* and *b* is lined by a single layer of columnar epi-
thelium and represents a portion of a cervical gland. Epithelium at *b* shows pronounced altera-
tion. The papillae are very irregular, show a tendency to clubbing, and apparently are increased
in number. In right half of *b* an occasional area shows some stratum corneum and a few super-
ficial granular cells are present suggestive of a fragment of stratum granulosum. Layer forma-
tion is not entirely lost, for some areas show a thin layer of spinal cells. Generally there is
marked irregularity in size, shape, and staining reaction of the cells. There are numerous spindle
cells, mitotic figures, and some epithelial whorls. Left half of *b* shows gland partially filled with
stratified epithelium. (Martzloff—*Am. J. Obst. and Gynec.*)

Fig. 638.—From the blocked area in Fig. 637. At *a* are large multinuclear cells. At *b* is
the remnant of a cervical gland. The majority of the cells in this area are of the spinal cell
type but show most unusual irregularity in shape and staining reaction. Mitoses are present.
(Martzloff—*Am. J. Obst. and Gynec.*)

The question as to whether or not cells presenting such marked erratic activity are already on the way to invasive development and should be considered and treated as cancer is taken up under the Diagnosis of Cancer of the Cervix. There additional points are illustrated by slides, one of which shows a leucoplakia with erratic cell changes, pronounced benign, which ten months later was invasive cancer.
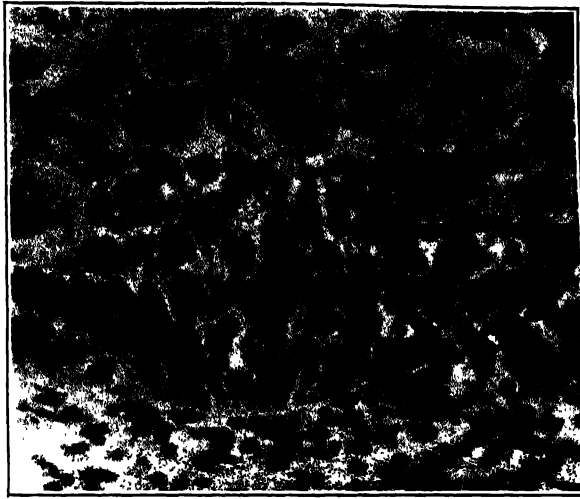
Fig. 639.—From the blocked area in Fig. 638. This shows the marked cellular irregularity. Mitotic figure at *a*, huge, coarsely granular oval cell at *b*, and large multinuclear cell at *c*. (Martzloff—*Am. J. Obst. and Gynec.*)
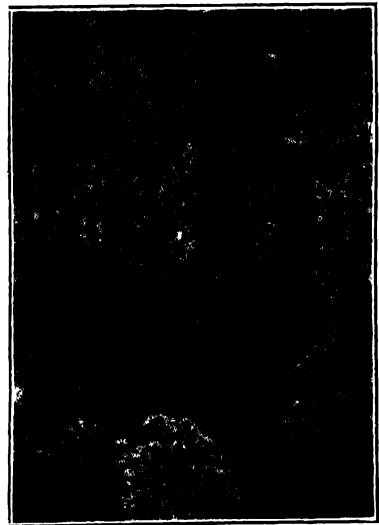
A. B.

Fig. 640.—*A*, Healing erosion for comparison with leucoplakia. Hyperplastic epithelium with uniform cells, regular layer formation, and no mitosis shown at *a*. Cervical glands, one of which is partially lined with stratified epithelium, *b*. Cervical canal, *x*. *B*, High power of blocked area seen in *A*. Note the uniform size, shape, and staining reaction of the cells. (Martzloff—*Am. J. Obst. and Gynec.*)

Leucoplakia of the cervix should be promptly removed, the same as any other area of chronic irritation. There is likely to be associated irritation in the form of erosion or cyst formation, and the whole affected area should be

removed by conization or conical excision. In this connection it is to be remembered that when the specimen is removed, the color distinction disappears. On this account it is important, before removing such a specimen, to mark the leucoplakic area with one or two small sutures just outside the boundary; otherwise it may be missed in the laboratory.

Symptoms and Diagnosis of Chronic Cervicitis

The principal symptom of chronic cervicitis is chronic vaginal discharge. Associated with this, but due principally to accompanying lesions (laceration of pelvic floor, uterine and adnexal inflammation), there may be a sense of weight and dragging in the pelvis and also backache. Most of the cases of very persistent free leucorrhea are due to chronic cervicitis, though, of course, the other causes of leucorrhea must be taken into consideration. Fulkerson found cervicitis in 33 per cent of 6,483 adult women.

Chronic cervicitis must be distinguished in the first place from inflammation or other lesion higher in the uterus or adnexa. There is a tendency to concentrate attention on an obvious lesion which can be seen through the speculum, such as cervicitis and laceration of the cervix, and miss higher lesions. When present, such a higher lesion, though less obvious at examination, is usually much more important as a factor in the patient's disability. In fact, a complaint of pelvic pain and disability is an indication of some disturbance in addition to the cervicitis, and careful search should be made accordingly.

As to the local condition in the cervix, the appearance and palpation findings of chronic cervicitis are so characteristic that there is little trouble in making the diagnosis. Tuberculosis or syphilis occasionally produces a confusing lesion of the cervix and should be thought of in atypical conditions there. A young married woman seen recently had just moved from a distant city where she had been given a partial radium treatment for a supposed carcinoma of the cervix. The examination findings were not typical of carcinoma nor of chronic cervicitis. A Wassermann examination gave four-plus reaction, and subsequent developments showed clearly that the trouble was syphilis, treatment for which cleared the local lesion.

The principal diagnostic difficulty in connection with chronic cervicitis is the question as to whether or not there is beginning malignant disease. Chronic cervicitis, in its various forms and with its long-continued irritation, is an important factor in the development of cancer in this situation. This is readily appreciated when we consider the persistent irritation from erosion, eversion, and cyst formation, with the resulting proliferative cell changes in this danger area where two types of epithelium meet.

Carcinoma of the cervix develops usually on a base of chronic cervicitis. No one can tell when the malignant development starts, for the microscopic change produces no symptom or sign in the really early stage. When appreciable induration or ulceration appears, cancer cells have already penetrated deeply—usually to the outlying portions of the pelvis. This important subject is taken up in detail under Cancer of the Cervix (Chapter IX) and hence it is not necessary to deal at length with it here. Suffice it to say that no

time should be wasted watching chronic cervicitis for evidence of cancer. The affected area should be eliminated promptly by appropriate treatment, before cancer develops.

The cancer-preventing results already definitely attained by such treatment are encouraging. Craig found that in 2,895 cases of cervicitis treated adequately and then followed for a period of ten years or more not one case of cancer of the cervix developed. Camperman estimated that cancer of the uterus is found in 4 per cent of all gynecological patients, and Frankl found that 89 per cent of uterine cancers are in the cervix. Consequently, in this one series of 2,895 cases followed, cancer of the cervix was prevented in 112 women.

Treatment

The treatment required for chronic cervicitis varies with the extent of the lesion. The following is a satisfactory plan for handling the different grades, advancing from the smaller to the larger lesions:

1. Puncture of cyst and astringent applications.
2. Linear cauterization.
3. Office conizacion.
4. Hospital conization, with added suture in some cases.
5. Conical excision with knife and extensive suturing.
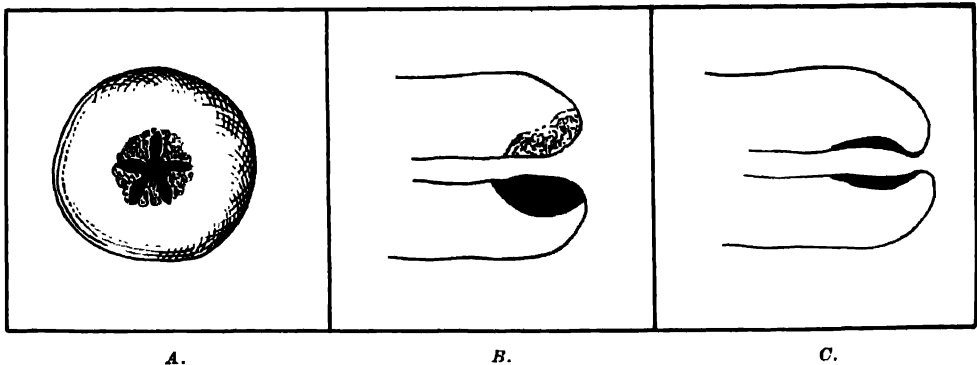
Fig. 641.—Linear cauterization of the cervix. *A*, showing the cautery incisions, and also the type of lesion suitable for this treatment; *B*, showing the deepening of the cautery incisions on the inside, so as to secure inversion from the scar contraction; *C*, indicating the satisfactory overcoming of the eversion, by the drawing-in effect of the inside scars.

1. **Puncture and Applications.**—When the cervicitis involves only a very small areas about the external os and the eversion is apparently kept up by a cyst or two, puncture of the cysts and an astringent application rubbed into the cyst cavities will sometimes clear the trouble and cause retraction. Astringent douches aid the process. Douches should be given often enough to prevent the accumulation of irritating discharge.

2. **Linear Cauterization.**—If the above treatment does not prove sufficient, or the small lesion is not of a type likely to yield to it, linear cauterization may be indicated. The condition most likely to yield to linear cauterization is the small eversion, the chronic inflammation being kept up by the eversion exposing the single-layered mucosa to vaginal irritation.

This treatment is carried out with the ordinary small cautery outfit, using a thin nasal cautery tip. A few radiating incisions are made, two to five, as thought necessary to draw in the everted area, by the contracting scars. Fig. 641, *A* gives a very good idea of the incisions and of the type of lesion suitable for this treatment. Care must be taken to make the cauterization incisions in such a way that the contracting scars will be effective in overcoming the eversion. To accomplish this, the inside part of the incision should extend rather deeply from the canal, as shown in Fig. 641, *B,* and the outside part
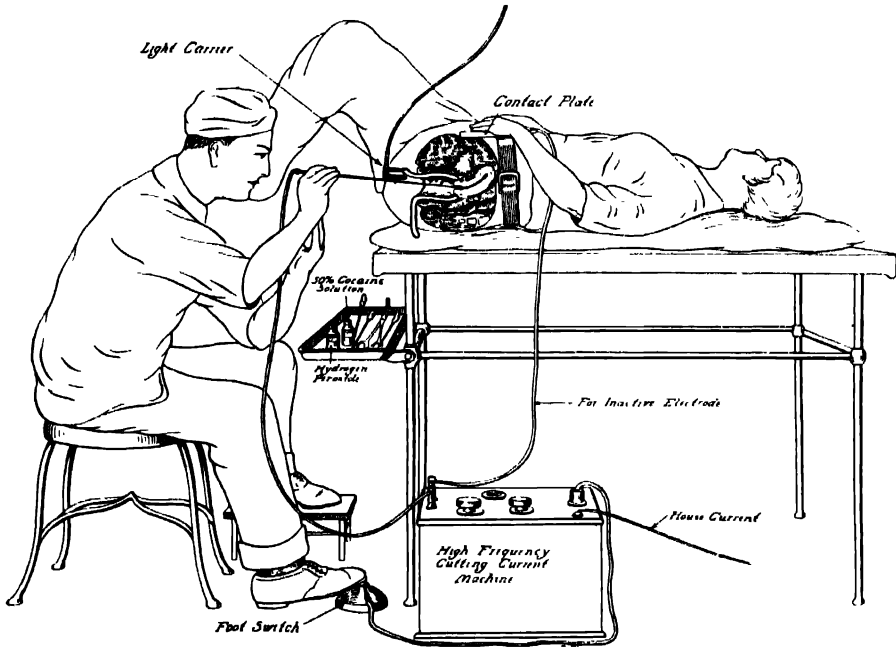
Fig. 642.—Schematic drawing of surgeon and patient during conization. (Hyams—*Am. J. Obst and Gynec.*)
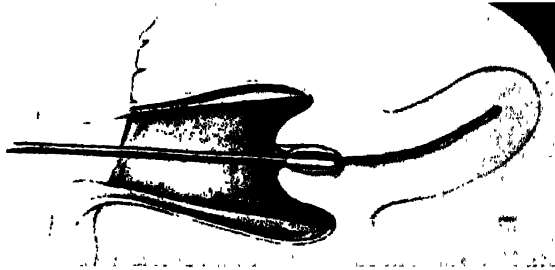
Fig. 643.—Hyams electrode in cervical canal. (Hyams—*Am. J. Obst. and Gynec.*)

should be limited to the involved area, so that all the contraction will be inside, as indicated in Fig. 641, *C.* If the incisions are extended too far out on the vaginal surface of the cervix, the outside contraction may prevent satisfactory inversion. Of course, any cysts present are punctured by the cautery.

There is ordinarily no pain from these small cautery incisions, and if they have good effect, additional ones may be made for any remaining small everted area. In making any additional incisions, avoid the new scars which are sometimes hypersensitive.

3. Conization.—If the small lesion of the type mentioned does not yield to the treatments given, it may be eliminated by office conization. This simple and satisfactory method of treatment was originated by Hyams and elaborated and the results reported by him in several articles. The general arrangements for conization are shown in Fig. 642, and the shape of his electrode and its position in the cervix are shown in Fig. 643. Hyams gave special emphasis to the removal of the endocervical mucosa. He shaped his electrode and technique accordingly and insisted that the removal of tissue should be limited to that within the canal and to the ⅛ inch width of his electrode.

In a study of these cases in conjunction with the use of the Hyams electrode one of us (R. J. C.) became convinced that a wider excision would be a marked advantage and devised an electrode for that purpose.
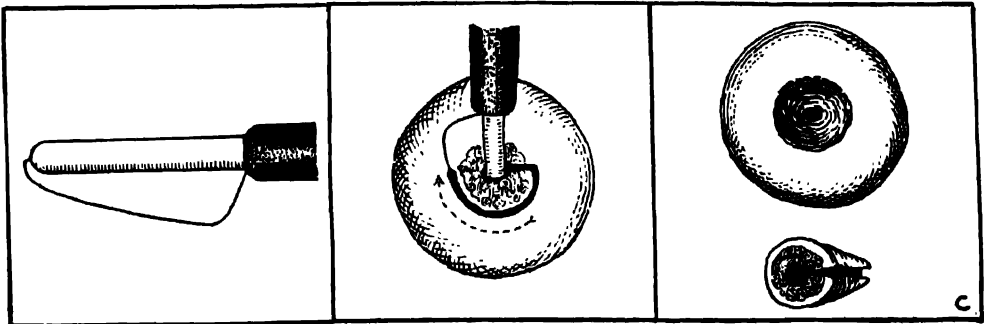
Fig. 644.   Fig. 645.   Fig. 646.

Fig. 644.—The new electrode for wider conization.

Fig. 645.—Indicating the method of using the electrode, i.e., a wide excision taking in all of the affected area.

Fig. 646.—The excised cone of tissue; also, the remaining funnel-shaped cavity, which heals rapidly with good inversion. (R. J. Crossen—*J. Missouri M. A.*)
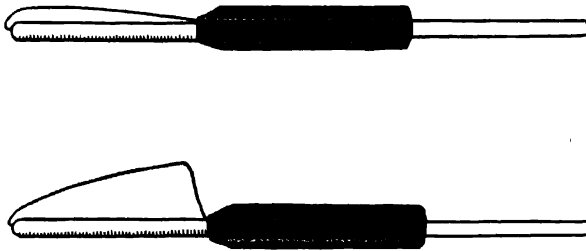
Fig. 647.—Upper electrode a Hyams, wire is one-eighth inch from the central core. Lower electrode is a medium-sized Crossen used for the wide conization to include all of diseased tissue. (Crossen—*Am. J. Obst. & Gynec.*)

The details of this electrode and its action, and our use and experience with it in office and hospital work, are given in the article, A New Electrode for Conization of the Cervix, from which the following quotations are taken:

While the Hyams electrode worked well in nulliparous cases, it was not satisfactory in cases of eversion with wide erosion and cyst formation. Its cutting wire was too close to the silicon tube to allow removal of a good-sized cone of tissue, including all the infected area. In order to overcome this difficulty there was need of a different type of electrode. I drew some sketches of the kind desired and wrote to various diathermy firms but they had none. Finally one of the firms offered to make up some according to specifications, for trial. After experimenting with different ones, the type shown in Fig. 644 was found to accomplish best the desired excision.

The point of the active electrode is placed in contact with the cervix so that the silicon tube will go into the cervical canal as the cutting proceeds. The foot switch is then closed and the electrode introduced into the canal to the desired depth, and then rotated as shown in Fig. 645, removing a cone of tissue (Fig. 646). This electrode is shown in comparison with Hyams' in Fig. 647.

The advantages of this electrode and technique are as follows:

1. It enables one to remove all the infected tissue about the external os, including cysts extending outward on the surface.

2. It gives a larger piece of tissue for pathologic diagnosis. Also, the specimen includes the area where the columnar epithelium of the erosion extending outward meets the squamous epithelium, which is the area where carcinoma is most likely to start.

3. It extends the hemostatic cutting-current excision to a large group of cases formerly considered too extensive for it.

This larger group includes two classes of cases: first, those in which the moderate extension of the cervicitis outward from the external os can all be removed by the single rotation of the wide electrode, as shown in Fig. 646 and, second, those requiring additional turns of the electrode, as in Fig. 648, A, to remove more extensive infiltration and cyst formation.

A.   B.   C.
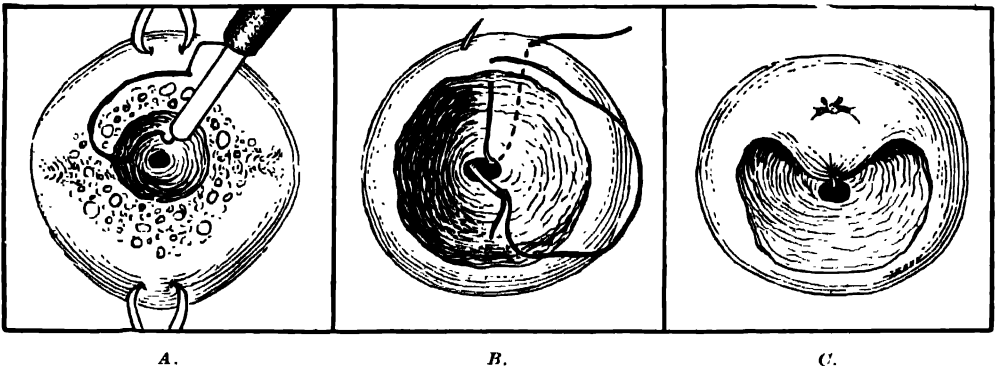
Fig. 648.—Very extensive conization, with use of a Sturmdorf suture on anterior lips to aid inversion during healing. A, the second round of tissue excision, after regular central conization; B, passing the Sturmdorf suture in the anterior lip; C, the first suture tied, showing the inverting effect. This also shows the open area left at each side, giving plenty of drainage opening for each flap. For hemostatic effect, the entrance and exit of the Sturmdorf suture should be separated about twice the distance shown in B. An additional Sturmdorf suture may be placed wherever needed for good inversion or hemostasis.

To maintain a wide canal it is well to introduce rubber tubing with a T-arrangement at the upper end, to prevent slipping out of canal, and at lower end to prevent slipping inside the uterus. (Crossen and Crossen—*Operative Gynecology*.)

In these extensive cases it was thought that inversion and rapidity of healing might both be facilitated by turning in the anterior and posterior lips with a Sturmdorf suture, as indicated in Fig. 648, B and C. The idea is not to make complete approximation of the raw surfaces as in conical excision with knife and sutures, but simply to start the inversion by drawing the outer margin well in by a single chromic catgut Sturmdorf suture in each lip. This suture also controls any bleeding tendency.

Hospitalization as for regular curettage is advisable in most cases requiring conization. Curettage also is frequently needed in these patients and at times other operative treatment which can be taken care of in association with the conization, such as radium treatment for myoma and plastic operations for cystocele, rectocele or relaxed floor.

In a later paper by R. J. Crossen and G. J. L. Wulff reporting three hundred conizations, they report also an improvement on the Crossen electrode by T. K. Brown. Instead of the fragile silicon central core Dr. Brown substituted a brass tube covered with insulating material. He also arranged the cutting wire so that it could be easily replaced, thus eliminating the necessity of sending the electrode away for repairs. These improved electrodes, which are almost unbreakable, are shown in Fig. 649.

Attention is called to the fact that the inverting suture, shown in Fig. 648, has been found very useful in hastening inversion and rapid healing. For good hemostatic effect, the entrance and exit points of the suture are separated sufficiently to include a large area of tissue between them. The suture material used is 40-day No. 1 chromic catgut.

From our experience we feel that sutures should be used in the following types of cases: (1) Wide conization where there is a good deal of eversion, regardless of whether they bleed at the time or not. (2) When there are bleeders at the time of conization. (3) When radium or a stem pessary is used. If the eversion is marked laterally or there is lateral bleeding, lateral Sturmdorf sutures can be used in combination with the anterior and posterior ones.
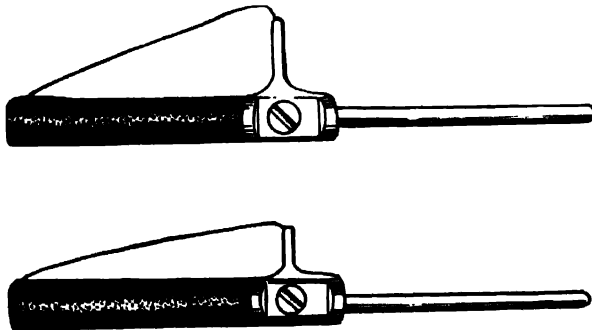
Fig. 649.—T. K. Brown modification of Crossen electrode. The unbreakable central core and replaceable cutting wire increase the durability of the electrode and reduce repair costs. (Crossen—*Am. J. Obst. & Gynec.*)

The use of the suture has allowed us to cone the more extensive cases of cervicitis, the type we used to feel needed the regular Sturmdorf operation, so that we now use the Sturmdorf operation only in cases requiring plastic repairs because of tears into the parametrium. The conization prevents most of the troublesome bleeding at the time of operation, and the removal of the infected tissue is ordinarily done more easily with the electrode than it is with the knife so that the time required is shortened.

This type of conization is very useful in removing chronic irritation from the cervix in cases of abdominal hysterectomy where for some reason it has been found advisable to do a supravaginal instead of the contemplated complete hysterectomy. After the abdomen is closed, the patient is arranged for vaginal work, and the irritated area about the external os is coned out, taking care to avoid deep penetration into the cervical stump. It has been found to work in well also with other operations, such as curettage, repair of the pelvic floor, and cystocele and prolapse operations.

In extensive conizations it is well to insert a tube drain past the internal os with T projections on each end to hold it in place. This is ordinarily left for several days, being removed in the regular examination just before discharge from the hospital. After some weeks, when the patient returns for the postoperative check-up, the canal is explored with a moderate-sized dilator to see that it is well open.

The tube for the cervical canal is a small item; but unless managed properly it may cause trouble, particularly if it is missing when the time comes to remove it. Has it slipped from the cervix and been washed out with the douche, and thrown away unnoticed, or has it slipped into the endometrial cavity? Those who have experienced this situation appreciate that it means anxiety for the physician and trouble for the patient. To prevent this occurrence two measures are advisable. 1. Make T projections, as shown in Fig. 650, on *each* end of the tube, to prevent it from slipping up or down. 2. Use
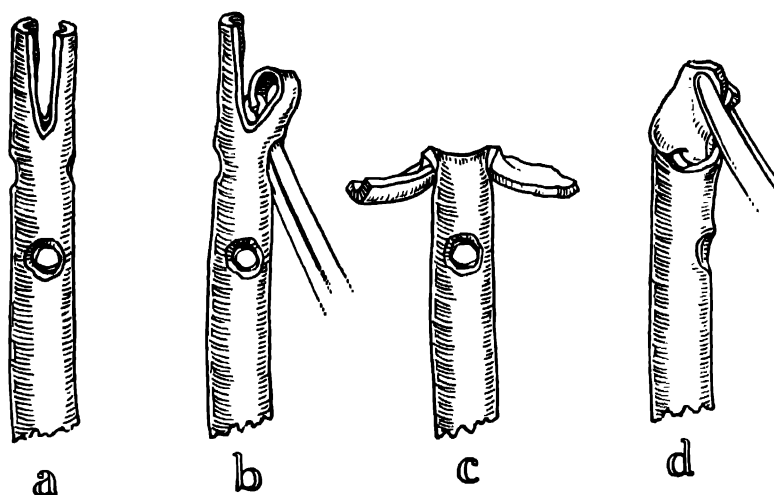
Fig. 650.—A good method of arranging the drainage tube to keep it from slipping out of the abscess cavity. *a.* The end of the drainage tube, showing the split in the end and the small opening at the base of each flap. *b.* Drawing one of the flaps through the opening at its base. *c.* Both flaps drawn through. *d.* The flaps bent up and grasped with forceps preparatory to introduction of the tube into the abscess cavity. (Crossen and Crossen—*Operative Gynecology*)

red rubber tubing, which is opaque to x-ray, so that if any question arises as to whether the tube is in the uterus, an x-ray film will show its presence and location.

The black rubber tubing ordinarily used for drains cannot be satisfactorily identified by x-ray. Crossen and Scott conducted experiments on the x-ray visibility of drainage materials, and those interested will find full details with illustrations in the article. One of the results was the adoption of red tubing for the various drains used in vaginal and abdominal surgery. The four sizes of red rubber tubing adopted are shown in Fig. 651. A No. 2 size tube drain with T projections on each end is shown in place in the cervix after extensive conization, in Fig. 652.

4. **Conical Excision With Knife and Extension Suturing.**—This is a safe and reliable method of taking care of extensive chronic cervicitis with the usual accompanying laceration, infiltration, eversion, and cyst formation. It

was devised by Sturmdorf and was a marked advance over the methods of repair then in use. This method not only excises the whole cystic area, but also covers over the raw surfaces in a most satisfactory way by means of the special Sturmdorf suture. With improved suture materials and advances in technique, the details as carried out today differ greatly from those first used, but the principles of the operation remain the same. The two important principles are, first, removal of the whole affected area by a cone-shaped excision (Figs. 653 to 655) and, second, turning in of an anterior and posterior flap by means of the ingenious Sturmdorf suture (Figs. 656 to 658). In any method of excising the affected tissue and repairing the cervix, the danger of subsequent stenosis of the canal must be kept in mind and guarded against. The dangerous area in this respect is the region of the internal os. Fortunately, as the laceration is in the lower part of the cervix the subsequent chronic inflammation and cystic change usually affect only the lower half or two-thirds of the
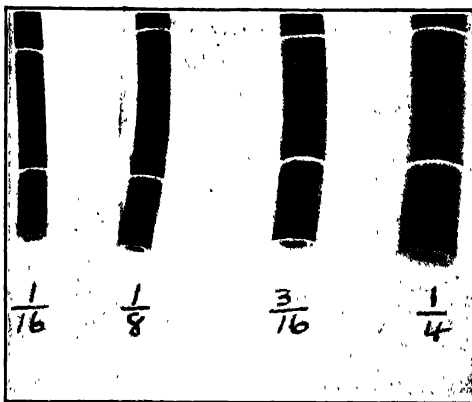
Fig. 651.   Fig. 652.

Fig. 651.—A photograph showing red tubing in the four sizes of tubing ordinarily used for drainage purposes. Starting with No. 1 which is the common red Dakin tubing the sizes run about as follows: Size No. 1, 3/16 inch outside diameter, order by hole 1/16 and wall 1/32 inch; size No. 2, 1/4 inch outside, order by hole 1/8 and wall 5/64 inch; size No. 3, 5/16 inch outside diameter, order by hole 3/16 and wall 1/16 inch; size No. 4, 3/8 inch outside diameter, order by hole 1/4 inch and wall 1/16 inch.

Fig. 652.—A roentgenogram showing a red tube drain (size 3) in position in the cervix in a patient convalescing from extensive conization of the cervix and curettage and repair of floor. There is a T formation at the upper end as well as at the lower end but at such an angle to the film that it does not show well. (Crossen and Crossen—*Foreign Bodies Left in Abdomen*, The C. V. Mosby Co.)

cervical mucosa. It is quite unusual to find much cystic change in the upper third; consequently, the line of excision may be kept well away from the internal os. Laterally, also, the excision of tissue should be limited to what is necessary for removing the chronic irritation. Unnecessarily extensive excision in any direction increases the troublesome bleeding and the chance of later stenosis. In doing the operation the conical excision should include the lower half or two-thirds of the mucosa, depending on conditions, and laterally just enough to remove the cystic tissue. When the cone is out, the remaining surface is examined, and if any cyst is found it is removed.

Another item of importance is the troublesome bleeding which interferes with the work. The authors experimented in various ways, seeking the best method of control. Preliminary circular ligation of the cervix and other forms of preliminary ligation or lateral clamping interfered more or less with the excision and suturing. Pressure hemostasis of the bleeding points was
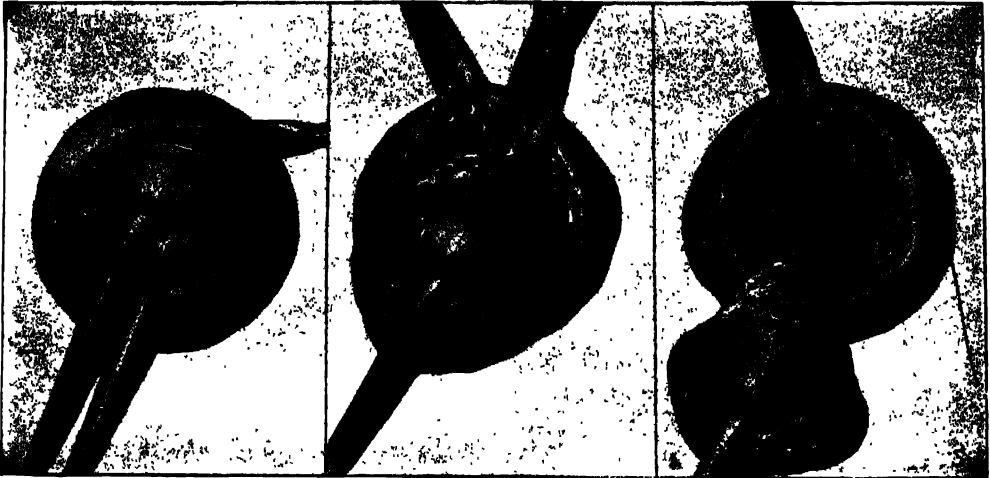
Fig. 653.   Fig. 654.   Fig. 655.

Fig. 653.—Conical excision of the cervix (Sturmdorf). Outlining the area to be removed. No more cervical tissue should be removed than is necessary to insure the removal of the chronic irritation.

Fig. 654.—Excising the deeper portions of the cone.

Fig. 655.—The cone excised, showing the resulting large raw surface, which bleeds freely. (This series of illustrations from Crossen and Crossen—*Operative Gynecology*.)
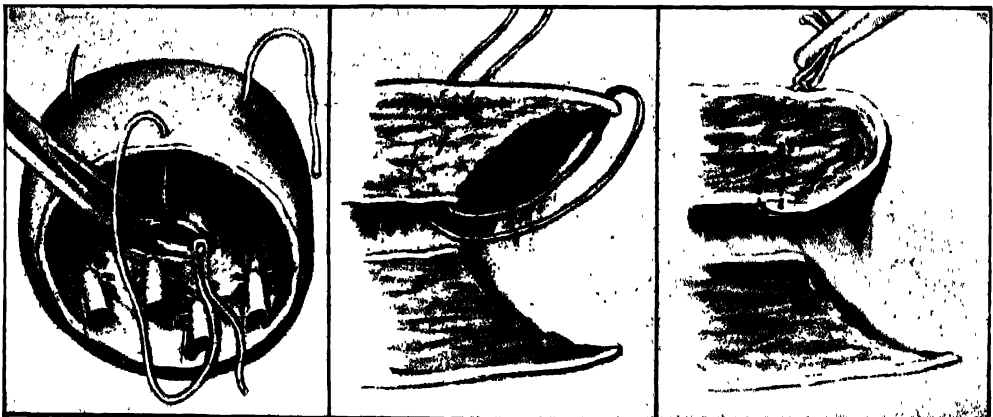
Fig. 656.   Fig. 657.   Fig. 658.

Fig. 656.—The anterior main suture has caught the anterior margin to be turned in and is being passed back from the canal to the vaginal surface of the cervix.

Fig. 657.—A sectional view showing the course of this Sturmdorf suture.

Fig. 658.—The suture tied, doubling in the thinned-out rim of the cervix as a flap over the raw area.

finally adopted. It is simple and satisfactory. Though it does not stop all bleeding, it reduces it sufficiently to permit accurate work and to obviate undue blood loss. As soon as the cone is out, the principal bleeding points are rapidly caught with strong toothed forceps. By judicious placing of the

forceps the bulk of the bleeding may be controlled, usually by six to eight. The forceps are left undisturbed a minute or two for pressure hemostasis, before proceeding with the next steps, shown in the illustrations.

In some cases, particularly where the cervix is fixed by scars, there may be difficulty in passing the main sutures in the regular way, especially the 'posterior suture. This difficulty may be overcome by putting a needle on each end of the suture and introducing each end from within outward through the canal. Another maneuver for overcoming the difficulty is to bring the needle out at the middle of the raw surface and then take a bite to carry the suture into the canal.

The extension of the field of conization with the high frequency wire loop, as previously explained, has obviated the necessity for this conical excision with knife and extensive suturing in all but exceptional cases. Occasionally the infiltration will be so extensive or the cervix so drawn out of shape by scars, that conical excision with the knife is preferable to attempting the

A.   B.   C.
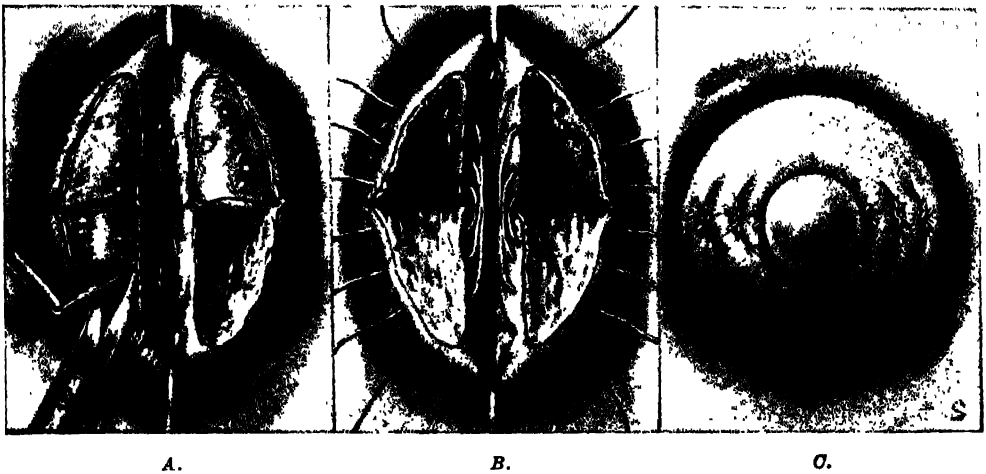
Fig. 659.—Repair of lacerated cervix (trachelorrhaphy), *A*, Denuding on each side of the canal, with more or less excision of cysts and infiltrated tissue. For this a knife or scissors may be used. A very convenient way is to start the process with the knife and finish with scissors. *B*, All sutures passed and ready to be tied. *C*, All sutures tied and the stem in place.

irregular excision with the conization electrode. In certain cases the suspicious area of particular interest may be situated in the canal, where it would not be completely excised by the deep small end of the electrode. In the case of a very vascular cervix and associated intrauterine treatment, one may feel surer of hemostasis with the extensive suturing of regular conical excision. When no satisfactory conization apparatus is at hand, one may make ordinary conical excision with the knife.

Trachelorrhaphy.—The operation of trachelorrhaphy (Fig. 659), formerly employed for the repair of the cervix in these cases, has been superseded by the more effective methods just explained. In the cases with enough pathologic change and chronic irritation to require repair it is preferable to remove all the involved tissue, instead of leaving a strip on each lip, as was necessary in the old trachelorrhaphy. Possibly there may be some exceptional cases of unilateral tear or of bilateral tear without much inflammation, in which this

lateral denudation and suture would be preferable. But it is now principally of historical interest, as an important step in the gradual development of effective treatment for this condition.

Coagulation.—Another method of removing the affected portion of the cervix is by electric coagulation, with sloughing of the coagulated tissue and subsequent granulation of the wound. This method has had a popular run, reminding one somewhat of the widespread popularity years ago of deep destructive cauterization of the cervix. The latter was finally abandoned on account of serious late results from the extensive scar-tissue formation. Whether or not electric coagulation, with its associated sloughing, will show similar results remains to be seen. For the present, it seems to run counter to an important principle of the handling of suspicious tissue in this area— namely, that such tissue should always be removed in a way which will permit of microscopic investigation of it. Of course, a specimen may be removed before the area is coagulated, but carcinoma may be beginning in another part of it. The safest plan is to remove the whole area as a specimen, and examine all of it, as is done in the other methods. Additional disadvantages of the coagulation method are extensive sloughing, occasional serious spread of infection, and the long period of healing.

Coagulation and the experimentation and clinical work connected with it constitute an important step in the long search for the best method of handling these cervix cases, and much credit is due the men who have conducted the work and carefully reported their results. The authors feel, however, that a judicious consideration of available information at this time indicates the adequacy and decided superiority of the methods advised and described in detail in the preceding pages.

Other methods of treating cervicitis have been employed, including ionization and carbon dioxide snow, but at present the methods already detailed seem definitely the preferable forms of treatment.

In cervicitis during pregnancy it would seem safest to employ palliative measures, to remove the irritating discharge and prevent aggravation of the trouble. There may be exceptional cases, however, in which the irritation is so marked that the danger of allowing it to continue would seem greater than the danger of more radical measures with the possibility of associated miscarriage. King and Touff report a series of 48 cases treated by fairly deep linear cauterization between the twentieth and thirtieth weeks of pregnancy.

ULCER OF CERVIX

An ulcer of the cervix is an area on the cervix which has lost its epithelial covering down to the connective tissue, the base being formed by granulation tissue or slough. It differs from erosion in that it is without epithelium on the surface, as shown in Fig. 660.

An ulcer in this location may be due to simple irritation or nutritional disturbance or may be due to chancroidal infection, syphilis, tuberculosis, granuloma inguinale, lymphogranuloma inguinale, or cancer.

The most prominent symptom of ulcer of the cervix is vaginal discharge, which is sometimes streaked with blood. When the cervix is exposed with

the speculum, the ulcer on its surface comes into view. The ulceration may be large or small, superficial or deep. It often bleeds when touched.

The conditions that may be confounded with ulcer of the cervix are erosion of cervix and laceration of cervix with eversion of mucosa. In **erosion** the lesion is very superficial and usually surrounds the external os, and the whole surface is still covered with epithelium. The cause is usually apparent and there is no raised clear-cut border or sunken base. In **laceration** of cervix with eversion of mucosa, the laceration is apparent, and by clearing all secretion from the reddened surface and examining it closely, it can be seen that it is mucous membrane and not granulation tissue.

A.　　　　　　　　　　　　　　　　　　B.

Fig. 660.—*A*, An ulcer of the cervix. Squamous epithelium is seen at upper and lower end but is absent over the surface of the ulcer between. *B*, Upper end of section shown in *A*, under higher magnification. The layer of squamous epithelium terminates abruptly at the edge of the ulcer. Gyn. Lab.

Simple Ulcer.—Simple ulcer of the cervix may be due to either of two etiological factors or a combination of both. One of these factors is local irritation, as from an irritating purulent discharge or the pressure of a pessary or rubbing of clothing on a prolapsed cervix, and the other factor is nutritional disturbance of the protective epithelium by endocrine or vitamin deficiency. These causes of ulceration have already been considered under simple ulcers of the vaginal wall, and the same irritations and local nutritional deficiencies are to be looked for about the cervix.

The important thing is not to make a diagnosis of simple ulcer until the other and more serious forms of ulceration have been definitely excluded. On the other hand, an ulceration appearing about the cervix after apparent cure

of cervix cancer should not be hastily pronounced cancer recurrence. A microscopic section may show it to be a simple ulcer, due to the combination of hormone deficiency and local radiation effect necessarily associated with curative treatment of cervix cancer.

Chancroidal Ulcer.—A rapidly spreading ulcer on the cervix with under-mined or punched-out edges, following suspicious intercourse, is probably chancroidal, and will usually have lesions on the vulva, as already described under Chancroid.

Syphilitic Ulcer.—If the ulcer is syphilitic there will be other evidences of syphilis and spirochetes may be recovered from its surface. The local find-ings in syphilis of the cervix depend on which stage of the disease is present.

A.   B.

Fig. 661.—*A*, Syphilis of cervix, secondary. Section through a slightly elevated grayish white plaque a little less than 1 cm. in diameter. At the bottom of the picture the epithelium is practically normal. In the lesion, note the regular character of the epithelium and its line of demarcation, the marked development of the epidermis, and the marked stratum granulosum, which is scarcely apparent in normal cervical epithelium. *B*, High power of the upper central portion of *A*. Shows the squamous epithelium in which the cells have a definitely water-logged appearance. The epithelium is markedly hypertrophic and presents the characteristic underlying irregular surface. Note the large cells of the stratum granulosum and also the well-developed stratum corneum. Gyn. Lab.

It must be remembered that occasionally a primary chancre is located there. This probably occurs more frequently than is realized but is not seen because of the hidden location of the lesion. Gellhorn and Ehrenfest in their compre-hensive work state that it occurs in 1.5 per cent of all genital lesions, but according to Oppenheim the frequency is 8 per cent. The lesion is transitory and therefore is rarely seen. It appears as an indurated ulcer, runs a rapid course, and heals leaving little or no scar. The lymph glands draining this

A.   B.

Fig. 662.—*A*, Syphilis of cervix, tertiary, showing numerous small gummas, each containing a giant cell. *B*, High power of one of the typical giant cells seen throughout this lesion. Gyn. Lab. (Schwarz—*Am. J. Obst.*)

Fig. 663.—Tuberculosis of the cervix uteri. Notice the cervical glands at the right and the exceptionally well-formed tubercle with giant cell at the left. There are several tubercles which show a tendency to coalesce. The patient was an eighteen-year-old nulliparous colored girl. Wassermann negative, and persistent antisyphilitic treatment had no effect on the lesion. The microscopic picture was typically tuberculous, with the characteristic caseation which distinguishes these tubercles from the gummas of syphilis. Gyn. Lab.

area are in the pelvis, so the inguinal glands are rarely enlarged. During preg-
nancy, the chancre is very persistent and because of it, accompanying induration
may interfere with delivery.

In syphilis of the cervix the microscopic findings vary with the lesion
present. In the primary stage, there is a marked round cell infiltration espe-
cially marked around the blood vessels. Plasma cells and giant cells are usually
present. There is very little loss of the surface epithelium in this early stage.
The second stage, condyloma latum, shows an exaggeration of the first stage plus
a loss of the epithelium over the surface, with ulceration. In the third stage
(gumma) there is edema and hypertrophy of the epithelium and necrosis. Figs.
661 and 662 show syphilis of the cervix.

Tuberculous Ulcer.—In tuberculosis of the cervix, scrapings from the sur-
face should show tubercle bacilli and section of tissue the characteristic
tubercles and giant cells, as shown in Fig. 663. Stevenson reported a series of
cases, and gave the following summary:

1. Eighteen cases of tuberculous cervicitis are reported, one of which is the sole
tuberculous focus of infection in the genital tract, and the only one active in the patient.
2. Tuberculous cervicitis is of chief interest because it clinically resembles carci-
noma and it announces the presence of genital tuberculosis.
3. The cervix is involved in from 5 per cent to 8 per cent of the cases of genital
tract tuberculosis and thus appears to have a relative immunity to infection. About 90
per cent of the cases of cervical tuberculosis are secondary to upper genital tract infection.
A true primary cervical tuberculosis is extremely rare.
4. The two chief symptoms are a persistent offensive watery leucorrhoea and bleed-
ing following coitus or douching.
5. Physically the cervix shows symmetrical hypertrophy and superficial friability,·
and the portio may show abnormalities ranging from erosion and eversion to ulceration or
papillary granulations.
6. The treatment should be surgical when possible and as radical as necessary and
as the condition of the patient will allow.

Counseller and Collins reported 109 cases—one of their own and 108 from
the literature. Some years later, Collins reviewed the subject and brought the
list of reported cases up to 191, and the following quotation as to treatment is
from his article:

The treatment of tuberculosis of the uterine cervix should preferably be of a radical
surgical character, such as abdominal panhysterectomy with the possible preservation of
one ovary, if the patient's condition and other factors are favorable, because usually ex-
tensive tuberculous disease of the upper pelvic part of the generative tract is present and
must be eradicated if cure is to result. For that reason and because of the rarity of a
primary tuberculous infection of the cervix, local treatment of the cervical lesion is not
advisable. For similar considerations roentgen and radium therapy will often prove to be
disappointing in their end results.
The contraindications to the employment of surgery are advanced local tuberculous
lesions with extensive involvement of the neighboring bladder or rectum, extensive tuber-
culous salpingitis, marked secondary infection, the presence of active tuberculous foci else-
where, cardiovascular disease and senility. The ultimate prognosis in this disease entity
is dependent on the type of treatment employed and on whether active tuberculosis is
present elsewhere in the body.

Granuloma Inguinale.—This form of ulceration of the cervix has been
reported by different writers. Pund, Huie and Gotcher found 9 cases of granu-

loma inguinale of the cervix in 67 negro patients with noncancerous disease of the cervix requiring specimen excision.

Fig. 664 is from an article by Arnell and Potekin, who gave the following summary:

1. Thirty-eight cases of granuloma inguinale of the cervix were observed at Charity Hospital of Louisiana during the ten-year period ending July 1, 1939, 21 of the number being identified within the last two years. Four of the patients were white, and represent the first instances of this disease to be reported in white women.

2. The clinical and histopathologic features of the lesion are discussed. The diagnosis is dependent upon the demonstration of the pathognomonic cell-containing Donovan bodies, which are most readily identified by the use of fixed biopsy material and the silver impregnation method of Dieterle.
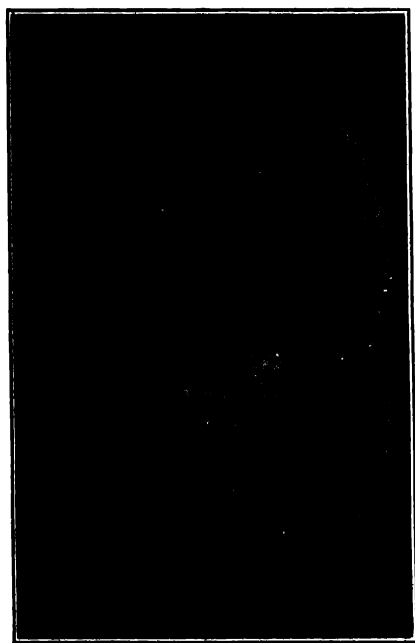
Fig. 664.   Fig. 665.

Fig. 664.—Early granuloma inguinale of the cervix. Note the close resemblance of the lesion to a cervical erosion. (Arnell and Potekin—Am. J. Obst. & Gynec.)

Fig. 665.—Section from lesion of cervix. Note characteristic cell of granuloma inguinale and arrangement of bodies within intracytoplasmic cysts, upper left. Two other cells, not in focus, indicated by arrows. Hematoxylieosin. Slightly reduced from photomicrograph (× 1,440). (Pund and Greenblatt—J. A. M. A.)

3. Carcinoma of the cervix is easily confused with cervical granuloma inguinale, and 27 of the 38 cases in this series were so diagnosed. The close clinical similarity of the two conditions is responsible for the error.

4. Vaginal bleeding and pelvic pain were the outstanding symptoms.

5. Intravenous antimony therapy is the most effective form of treatment, and tartar emetic gives the best results. The duration of treatment is shortened if large growths are completely excised by means of the cautery knife before specific therapy is begun. Recurrences are common.

6. Granuloma inguinale of the cervix is a clinical entity which demands general recognition and further study. Only by these means will the true incidence be established and improved methods of diagnosis and treatment be evolved.

Fig. 665, showing the microscopic features, is from an article by Pund and Greenblatt.

Lymphogranuloma Inguinale.—Ulceration of the cervix due to this cause would be accompanied with the more common lesions of this disease, which are described in Chapter IV.

Actinomycosis.—This vegetable fungus, known as the ray fungus and capable of causing extensive ulceration, has been found in the cervix. Jaffe reports a case and discusses actinomycosis of the uterus.

Cancerous Ulcer.—In any ulcer of the cervix, the determination as to whether or not it is a beginning cancer must be made promptly, excision of the area for microscopic examination being carried out if necessary.

Treatment of Ulcer of Cervix

The treatment of an ulcer of the cervix is indicated by the diagnosis as to the type of ulceration, which has been discussed above. The treatment of the various diseases causing noncancerous ulceration has been considered in Chapter IV under ulcerations of the vulva and vagina. Cancer of the cervix is considered in Chapter IX.

Fig. 667.

Fig. 668.

Fig. 667.—Cross-section of a cervical polyp. This is the solid type with no dilated glands showing.

Fig. 668.—High power of a cervical polyp of the glandular type. Gyn. Lab.

CERVICAL POLYPI

Cervical polypi is the term applied to small nonmalignant tumors found in the cervix uteri (Fig. 666). They are usually simple adenomas of the cervical mucosa and hence are frequently designated as "mucous polypi." Occasionally, a small myoma of the cervix or from higher will become pedicled and project from the cervix, constituting a polypus.

Ordinary cervical polypi are usually infected and frequently are of inflammatory origin. In the gross they resemble the cervical mucosa. Microscopic

Fig. 666.—Colored photograph of a fresh specimen, showing various points in gross pathology. A typical cervical polyp (mucus polyp) arises below the middle of the cervical canal and hangs to near the external os. It was not in sight on speculum examination of the patient in the office.

The opened uterus and cut surfaces give a good idea of the marked thickening of the walls, which enlarged the organ to the size of a fist. There is a diffuse myomatous process, with scattered small myoma nodules. Two of these show in the lower half—a sectioned one on the cut surface and a small submucous one projecting from the posterior wall. The operation was for disabling myomatous uterus with pressure symptoms. Gyn. Lab.

examination reveals a surface covering of cervical columnar epithelium. The polypi contain numerous cervical glands, many of which are cystic. The stroma shows a marked hyperemia, inflammatory infiltration, and edema. Round cells and plasma cells are numerous, and speak for the inflammatory nature of this condition. The microscopic features are shown in Figs. 667 and 668.

We had one case of mucous polyp in which the polyp was so long that it protruded outside the vagina for two inches. It would fill with mucus gradually, and intermittently it would empty through a small opening.
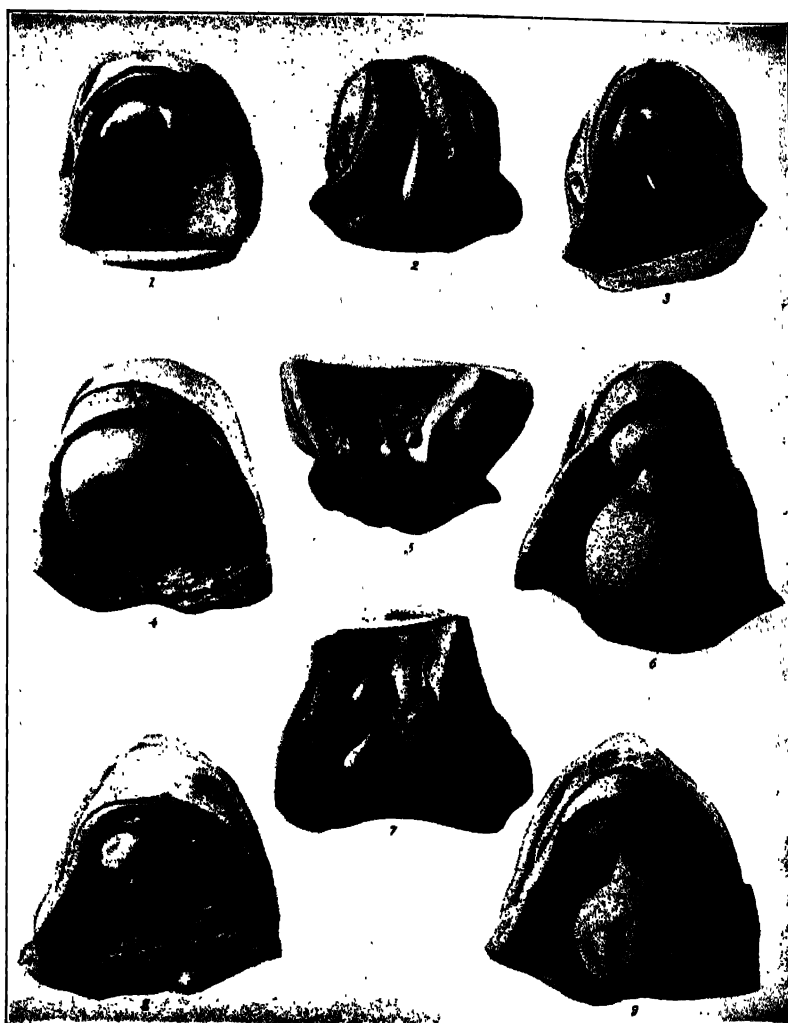
Fig. 669.—Showing different types of cervical polypi encountered in clinical work. (Hirst— *Diseases of Women.*)

Diagnosis and Treatment

The principal symptoms are bleeding and leucorrheal discharge. It is surprising what troublesome and persistent bleeding will sometimes be occasioned by a small polyp in the cervix.

On digital examination, the polyp may often be felt as a small soft mass projecting from the cervix or obstructing the external os (Fig. 669). In some

cases the polyp is so soft that it is not noticed on palpation, until the examining finger is moved slowly back and forth across the external os, when it will be felt to slip under the finger.

In the examination through the speculum, the polyp is seen (when low enough in the canal) as a small rounded red mass, projecting from the external os.

The important thing in the diagnosis is to distinguish beginning malignant disease from simple polyp. Not infrequently in malignant disease of the cervix, small projections form within the cervical canal and appear at the external os, presenting almost the same appearance as the simple polyp. Such a polyp is shown in Chapter IX, under Sarcoma of Uterus.

The treatment is removal and microscopic examination. The little mass of tissue may usually be grasped with the long dressing forceps and twisted off. An astringent-antiseptic application is then made, and a tampon or vaginal packing applied. If there is much bleeding, it is well to put a few drops of 1:1,000 adrenalin solution on the end of the tampon against the cervix. The tampon may be removed by the patient the next day.

All tissue removed from the cervix uteri should be sent for microscopic examination as already explained in Chapter II. If not a projection from malignant condition in the uterus, it is at least a product of chronic irritation and should be investigated.

HYPERTROPHY OF CERVIX

The term "hypertrophy" or "idiopathic hypertrophy" is applied to enlargement of the cervix independent of laceration and the resulting inflammation or of definite tumor formation. As this form of hypertrophy results principally in elongation, it is sometimes spoken of as "elongation of cervix." It is a rare affection.

Etiology, Symptoms, Diagnosis

The cause of this marked increase of tissue and elongation of the cervix is not definitely known. In some cases of prolapse of the uterus, the vaginal walls which prolapse at the same time drag on the cervix and elongate it, but not to the extent here contemplated. It may occur in the married or unmarried. It occurs oftenest in nulliparas, and this brings up the question of congenital or developmental defect.

There is an increase of tissue in the cervix but principally in a way that gives greatly increased length. If the hypertrophy takes place only in the infravaginal portion of the cervix (Fig. 670), the body of the uterus and the vaginal walls remain in approximately normal position, the long cervix projecting along the vagina or even outside of the vagina. Fig. 671 shows such a condition. If the hypertrophy is confined to the supravaginal portion, the vaginal walls, both anterior and posterior, are pushed downward by it, as in prolapse. The body of the uterus, however, remains in about the normal position. If the hypertrophy is confined to the intermediate portion, the anterior wall and the base of the bladder will be pushed down as in prolapse, the

posterior wall remaining stationary. Retroversion of the uterus and more or less prolapse are usually present also, and are caused by the dragging of the heavy cervix and the vaginal walls.

Examination reveals a mass with the characteristics previously mentioned. From prolapsus uteri it is distinguished by the body of the uterus being in approximately normal position. From uterine tumor, projecting into the vagina, it is distinguished by its form and by its central cavity. From inversion of the uterus, it is distinguished by the body of the uterus being in about the normal position, and by its central opening.

Treatment

The treatment of extensive elongation of the cervix, causing troublesome disturbance, is either amputation of the cervix or hysterectomy, the choice depending on the complications present.
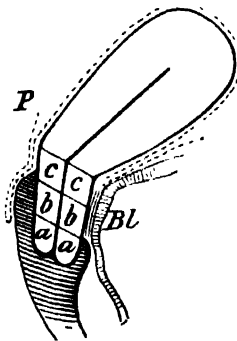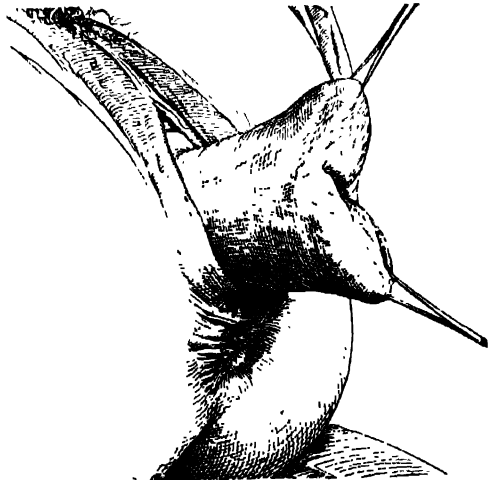
Fig. 670.   Fig 671.

Fig. 670.—The three divisions of the cervix; *a*, infravaginal portion; *b*, intermediate portion; *c*, supravaginal portion. (Byford—*Manual of Gynecology*.)

Fig. 671.—Hypertrophy of the infravaginal portion of the cervix. (Kelly—*Operative Gynecology*.)

HYPERPLASIA OF ENDOMETRIUM

Hyperplasia of the endometrium is a persistence and exaggeration of the growth phase of the monthly cyclic change. It is not an endometritis, though inflammation may be present as a complicating condition. In its various forms it has received various designations, being confused principally with endometritis. The former confusion regarding the pathology of the endometrium was due chiefly to the lack of knowledge concerning the details of the cyclic changes associated with menstruation.

Olshausen in 1846 first described the condition and called it "endometritis fungosa." In 1853, Brennecke again described the condition and noted that there was an absence of corpora lutea in the ovaries. He suggested that the ovarian disorder was the cause of the endometrial changes. For a time it was thought to be caused by inflammation, but Cullen in 1900 recognized it as a

benign condition distinct from endometritis. The fundamental work of Hitschmann and Adler on the changes in the histologic picture of the endometrium during a normal cycle, and the later work of Schroeder, laid the foundation for the understanding of this interesting endometrial lesion. Schroeder's work in Germany and the contributions of Cullen, Novak, Fluhmann, Burch and many others in this country, have done much to make our knowledge of this condition more complete.

Etiology

Endometrial hyperplasia is due to a disturbance of the normal changes that take place in the endometrium, which in turn are dependent on the ovarian-pituitary hormonal influences associated with ovulation and corpus luteum formation. The particular hormonal influences which seem most responsible are excess formation of estrin (endometrium growth hormone) and deficient formation of progestin (corpus luteum hormone). The particular ovarian lesion most likely to be associated with endometrial hyperplasia is the "cystic" ovary resulting from nonrupture of follicles. In the nonruptured follicle the ovum dies, but the zona granulosa continues to function, resulting in excess estrin and abnormal growth of the endometrium.

In most cases of hyperplasia in which the ovaries have been examined, there is an absence of a recent corpus luteum corresponding to the menstrual period. This fact led to the conclusion that the failure of ovulation in some way was responsible for the hyperplasia. Novak stressed the importance of persistent and excessive stimulation by estrin as a cause of the condition. Failure of follicle rupture caused a persistence of the follicle containing estrin and an absence of corpora lutea. Proof of these contentions has been produced by Burch, Williams, and Cunningham experimentally in rodents. They were able to produce hyperplasia by the injection of estrin, and also by using the fluid obtained from cystic ovarian follicles. Kaufmann, as has been mentioned under Physiology, produced hyperplasia in the human castrate by large amounts of the estrogenic hormone. Werner in this country has also succeeded in producing it. Burch studied specimens of endometrium from cases of hyperplasia of the endometrium in human beings at various times in the cycle. In one case a previous instrumentation evidently caused ovulation, so that when another specimen was removed in the premenstrual period the endometrium showed typical premenstrual changes, whereas with the previous periods it had shown a hyperplastic endometrium.

Concerning the primary cause of the failure of follicle rupture, that has been discussed under the physiology of the pituitary-ovarian cycle (Chapter I).

The cause of the bleeding in hyperplasia has been the subject of much discussion. There is a distinct difference between menstrual bleeding and the bleeding in these cases. In normal menstruation, the withdrawal of the estrin causes a cessation of growth and vitality of the entire endometrium, causing a necrosis and desquamation down to the basal layer, and the resulting bleeding stops in a few days. With the hyperplastic endometrium the necrosis occurs in small, widely separated areas and gradually extends so that two or three months may elapse before desquamation is complete, or it may never be complete. It seems that the failure of the endometrium to desquamate properly

may be the important factor in the prolonged bleeding, for when curettage is done and the endometrium removed down to the basal layer, the bleeding usually stops.

Pathology

In hyperplasia the endometrium is markedly thickened (Figs. 672, 673) and the glands are numerous and vary greatly in size and shape, some being much dilated. The mucosa may be so redundant as to form folds or even polypi. In curetting one usually obtains a large amount of endometrial tissue. When a large piece is seen, it is ordinarily a strip of fairly uniform thickness, instead of the chunky broken pieces obtained in endometrial carcinoma. Occasionally, however, there are polypi or other irregular thickenings which give the curettings the gross appearance of malignancy.

Fig. 672.

Fig. 673.

Fig. 672.—Hyperplasia of endometrium. Gross specimen showing greatly thickened endometrium, which is distributed in velvety folds. Gyn. Lab.
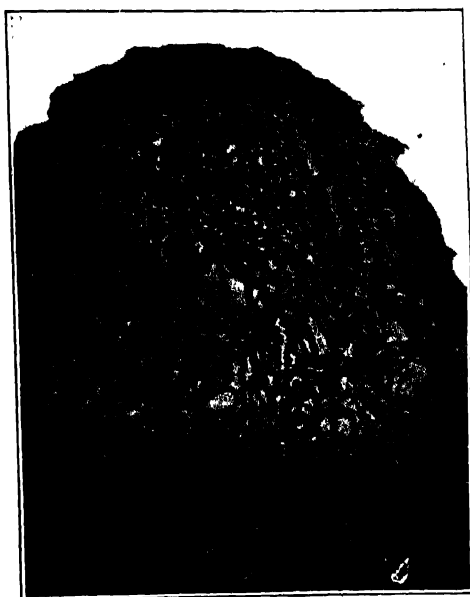
Fig. 673.—Low power picture of the endometrium in Fig. 672. Notice the thick endometrium, the greatly dilated glands, and the compact superficial layer. Gyn. Lab.

In hyperplasia there is evidence of varying degrees of excessive growth. In the mild form there is merely an increase in the number of glands and cells. The glands present no consistency in form. Some are in the early growth stage, others may be of the "saw toothed" stage, and some are cystic. The epithelium lining the glands varies from a flattened single layered epithelium to one which is pseudostratified, containing ciliated cells. Mitotic figures are very commonly seen. They are usually areas of edema, hemorrhage, and necrosis. The stroma may or may not show hyperplasia.

In the more severe cases there is a greater variation in the size of the glands, producing the well-known "Swiss cheese" appearance described by Novak. Glands are present representing all stages of the menstrual cycle, instead of all the glands being in about the same stage. The free border of

Fig. 674.—Hyperplasia of the endometrium of the "Swiss cheese" type described by Novak. Note the large cystic glands scattered throughout the endometrium. Gyn. Lab.

Fig. 675.—Hyperplasia of the endometrium. High power of Fig. 674 taken from an area a little to the right and above the center of the picture. Shows the character of the cells lining the endometrial glands and the surrounding stroma. Gyn. Lab.

the epithelial cells lining the glands is usually clear cut, and there is little evidence of secretion. The epithelium may be single or many layered. The necrotic areas are very noticeable in the advanced cases. This point has been stressed by Schroeder. Figs. 674 to 677 show the microscopic characteristics of different types of endometrial hyperplasia.

Polypi of Endometrium.—When endometrial polypi are present, there is usually associated general hyperplasia; in fact, the polypi apparently represent local exaggerations of the hyperplasia. The gross appearance and the microscopic characteristics of endometrial polypi are shown in Figs. 678 and 679. A polyp may act as a foreign body in the uterus, causing uterine contractions. If the pedicle becomes sufficiently elongated, the polyp is extruded through the external os, and can be seen on speculum examination. In such a case the pedicle may slough and the polyp be expelled spontaneously.

Fig. 676.

Fig. 677.

Figs. 676 and 677.—Curretting. Fig. 676, Hyperplasia of endometrium with increase in stroma. Fig. 677, Hyperplasia of endometrium, with cystic dilatation of glands. Gyn. Lab.

Occasionally a sarcoma or carcinoma of the endometrium will form a polyp which projects from the cervix and may be removed as a supposedly simple cervical polyp, hence the importance of microscopic examination of all tissue removed from the uterus, even apparently simple cervical polypi.

Symptoms and Diagnosis

Bleeding is the most common clinical disturbance from endometrial hyperplasia. In the typical cases associated with nonovulation, the bleeding loses the cyclic character dependent on ovulation and may persist for weeks at a time. Also there may be periods of amenorrhea between the spells of bleeding —that is, the absence of ovulation removes the cyclic influence which normally starts the flow as well as the influence which normally stops it.

This type of bleeding occurs principally in young persons in whom the normal endocrine cycle is not fully established or in the menopause period as the cycle is ceasing. In the active childbearing period with full establishment of ovarian-pituitary physiology, bleeding is more likely to be due to some local lesion, such as inflammation, or tumor, or local circulatory disturbance, though the local metabolic disturbances from these conditions may perhaps cause some hyperplasia.

The exact diagnosis of endometrial hyperplasia is dependent on microscopic examination of curettings, though the condition may be inferred in persistent bleeding in the young, as menstruation is being established, and in later life as it is ceasing. The clinical differentiation of this type from other types of uterine bleeding, by symptoms and observation and medication, is taken up in detail under Menorrhagia and Metrorrhagia in Chapter XIV.

Fig. 678.

Fig. 679.

Fig. 678.—Hyperplasia of the endometrium, which has extended to polyp formation. Photograph of gross specimen. Gyn. Lab.

Fig. 679.—Photomicrograph of the specimen shown in Fig. 678. Notice that the polyp is strictly endometrial. Gyn. Lab.

Treatment

The plan of medicinal and endocrine treatment for uterine bleeding, along with differential diagnosis as treatment proceeds, is given later under functional bleeding, as just stated. If the bleeding persists in spite of other measures, then curettage is indicated.

Curettage

FOR ENDOMETRIAL HYPERPLASIA, CHRONIC ENDOMETRITIS, UTERINE BLEEDING, AND INTRAUTERINE DIAGNOSIS

Attention must be called to the dangers of curettage, which is not the simple and harmless procedure many suppose. The uterine wall is easily perforated by the curette, or sound, or forceps, which perforation may cause fatal peritonitis. Curettage may cause serious aggravation of conditions in cases of pelvic inflammation or of tubal pregnancy. In other words, uterine curettage carries the dangers incident to a surgical procedure within a vulnerable organ situated in the peritoneal cavity, and it must be used with due skill and for proper indications only. Indiscriminate curetting of the uterus has done much harm through lack of skill in technique and lack of judgment in the choice of cases.
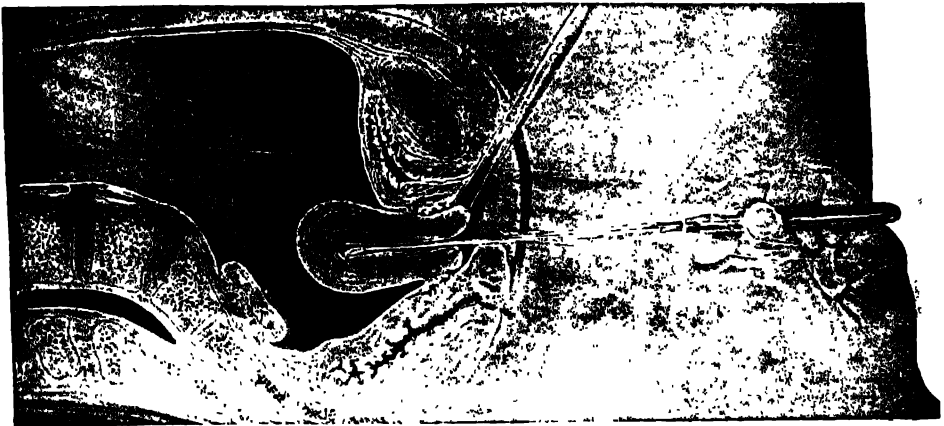
Fig. 680.—Method of holding the curette. It should be held like a pen, so that every graduation of force may be appreciated and regulated. The cutting edge of the curette is to be turned in every direction and the shank bent sufficiently to curette systematically all parts of the cavity.

After the patient has been prepared on the operating table and draped, it is well to make bimanual palpation and record the findings, as this deep palpation under anesthesia or analgesia may help to clear up some doubtful point as to conditions in the pelvis.

After the cervix is exposed by introduction of the retractors and grasped with tenaculum forceps, the cervical canal is cleansed with an antiseptic solution. The canal is then dilated with dressing forceps sufficiently to admit the large bladed dilator, or with graduated dilators as preferred. When the cervix is sufficiently dilated, the endometrial cavity is swabbed with an antiseptic solution on cotton held in the uterine forceps. At the same time the depth of the uterine cavity is determined with the cotton-tipped forceps, the distance from the external os, marked with the finger, to the end of the withdrawn forceps being measured with the graduated sound. This is much safer than using the sound in the uterus, for the tip of the sound may perforate the uterine wall on very slight pressure, which serious accident has happened many times.

The dilatation of the cervix should be carried out slowly and carefully, the direction of the dilatation being changed several times, to secure gradual dilatation in all directions and prevent rupture of the cervix. The cervix should, in this manner, be dilated sufficiently to admit the medium-sized curette easily.

In certain cases in which the cervix is abnormal, it may suddenly tear at some point and the blade of the dilator will pass through the wall of the cervix into the periuterine connective tissue. To prevent this accident it is well to keep the set-screw, at the handle between the blades, set so that there can be no sudden wide separation of the dilating blades.

When sufficient dilatation of the cervix has been secured, inject into the vagina some of the citrate solution (2 per cent solution of sodium citrate, to prevent clotting on the tissue-specimens, which is troublesome in the laboratory work) so that it will be carried into the cavity with the curette. The medium-sized curette is then introduced and the soft endometrium scraped away. The curette should be held tightly between the thumb and the fingers, in the same manner as a pen (Fig. 680). A mark on the handle indicates in which direction the cutting edge lies. The interior of the uterus should be gone over systematically, so that no part of the surface is missed. The pressure must be applied carefully. It must be firm enough to remove the softened diseased tissue, but not firm enough to remove any of the firm tissue beneath it. The fact that comparatively healthy firm tissue has been reached is indicated by the grating sensation imparted to the curette. As a rule, this is easily recognized and after some practice the uterus may be cleared out rapidly and safely. In exceptional cases, however, the wall of the uterus is diseased to a considerable extent and softened, and great care is necessary to avoid perforation of the wall.

Fig. 681.   Fig. 682.

Fig. 681.—Returning the uterus to its normal position after curettage, and making the bimanual examination under anesthesia. The examination under anesthesia may be made immediately before the curettage if preferred.

Fig. 682.—Putting in the vaginal packing.

After the surface of the cavity has been gone over carefully with the sharp curette, the débris is brought into the vagina with the curette, and then worked out of the vagina into the specimen basin by forcible injection of citrate solution with the tip of the syringe in the vaginal vault back of the cervix. The uterine cavity is then swabbed with dry cotton or gauze to gather up any loose fragments remaining.

When the cavity is believed to be clean, it is well to introduce the uterine forceps, open widely in the cavity, rotate some, close, and remove. In this way may be caught an attached shred or a loose roll that is not brought out by the swabbing. This little maneuver has saved the embarrassment of leaving in remnants on several occasions—one time the principal part of an incomplete miscarriage.

When the endometrial cavity is clear of remnants, it is well to make an astringent and antiseptic application, to check bleeding, kill bacteria carried

in from the cervix or cancer cells that may be in the cavity, and to seal lymph and blood spaces to prevent metastasis. For this purpose an application of carbolic acid (95 per cent) followed immediately by an application of alcohol has proved satisfactory. If there is persistent undue bleeding, the uterine cavity may be packed with gauze: otherwise packing is not needed.

When the operation is finished, cleanse the vagina, remove the speculum, introduce two fingers to the cervix and bring the fundus uteri well forward by bimanual manipulation (Fig. 681). In the curettage, the uterus is drawn downward somewhat and the fundus sometimes goes backward. Unless the uterus is brought forward into normal position at the close of the operation, it may remain in retrodisplacement and cause trouble. If intrauterine packing is used, the vaginal portion may be held in the palm of the hand (Fig. 682) during the replacement of the uterus.

After curettage the epithelial covering of the uterine interior is quickly regenerated from the epithelium of the remnants of glands remaining, and gradually the whole endometrium is restored.

After-care.—The vaginal and uterine packing is removed in about twenty-four to forty-eight hours, and an antiseptic vaginal douche is given once daily. The vulvar dressing is continued for a week. The patient may ordinarily get up in from two to four days after curettage, except when there is some associated disease that would be benefited by longer rest in bed.

Curettage is only one step in the treatment. After that endocrine investigation and treatment and other measures required for the condition should be carried out. Associated pathologic conditions, such as malposition of uterus, laceration of cervix, laceration of pelvic floor and pelvic inflammation, must also be corrected as far as possible, for if allowed to continue, the uterine congestion resulting therefrom will tend to delay recovery and may result in the re-formation of a thickened bleeding endometrium.

Wilson and Elden reported treating five women presenting the problem of uterine bleeding associated with hyperplasia, using progesterone in comparatively small doses. An interesting case of ours illustrated the recession of a very marked hyperplasia of the endometrium after the use of pregnant mare's serum. The patient had five curettements over a period of three years for recurrent bleeding and each time the endometrium showed a more marked hyperplasia. With the final curettage the condition was so marked that some of the pathologists thought that it was adenocarcinoma; there was sufficient difference of opinion, however, to justify observation. After this curettage there was no flow for four months; a series of four doses of 200 U of anteron was then given and this was followed by a period seven days after the last dose. The period lasted seven days and was normal except for severe pain. Following this we had planned to secure an endometrial specimen at the onset of the succeeding period, but there was amenorrhea for two months. Pregnancy could be excluded, and the securing of an endometrial specimen was attempted but had to be abandoned on account of the severe pain on trying to insert the small curette. Because of the marked proliferation seen on the previous curettage we felt that it was important to determine the condition of the endometrium before further treatment and hence performed another curettement. This time the report was normal interval endometrium, no evidence of

corpus luteum effect. After four months of amenorrhea the flow was initiated four days after completion of a series of six doses of proluton (10 mg.) or 60 mg. in all.

A very interesting question in this connection is whether or not endometrial hyperplasia in the late menopause period is an indication of a tendency to endometrial carcinoma. This is an important problem, and one concerning which additional dependable information is needed. R. J. Crossen and J. E. Hobbs made an analysis of our cases of endometrial carcinoma, and are investigating the subject in various directions. A preliminary report was made (J. Missouri M. A.), and the investigative work is being continued. Sufficient facts have already been accumulated to indicate that endometrial hyperplasia in late menopause (fifty) may be taken as a sign of a definite tendency to endometrial carcinoma. So strong is this indication that in a patient menstruating at that age we advise stopping the undue endometrial activity by radium treatment, which is accompanied, of course, by curettage and microscopic investigation to determine whether or not carcinoma has already started.

MEMBRANOUS DYSMENORRHEA

Membranous dysmenorrhea is the term applied to that form of painful menstruation accompanied by the expulsion of membrane from the uterus. The membrane is usually passed in small pieces, though occasionally it is thrown off as a complete cast of the interior of the uterus. It consists of the superficial layers of the uterine mucosa (endometrium), and is thrown off en masse as the result of nutritive changes which are not yet fully understood.

The pains come with the flow and are paroxysmal—of the same character as the pains of mechanical dysmenorrhea, but very severe, resembling labor pains. After these have continued for several hours or a day or two, pieces of the membrane are expelled. There is then relief unless other pieces pass. The membrane, mixed with the menstrual flow, is the diagnostic sign of this form of dysmenorrhea. Care must be exercised not to confound it with miscarriage. It usually recurs every month or so and may last for years.

The condition may appear at puberty or at any time during menstrual life. It is more common in sterile women, the same functional disturbance causing the membranous dysmenorrhea may be a factor in the sterility.

Etiology and Pathology

Hitschmann and Adler proved that it was not of inflammatory origin and Aschheim confirmed this, finding that the endometrium was bacteriologically sterile. Halban feels that there is an endocrinologic factor which causes premature uterine contractions with separation of the endometrium en masse at the level of the functional layer.

Gross.—These specimens are usually brought in by the patient in a piece of paper or cloth all dried out. Patients who complain of passing tissue with each period should be instructed to place the tissue in a bottle of 10 per cent formalin immediately after it is passed.

The membrane as a whole does not stain as clearly as it does in uteri removed at operation or in curettage specimens. There is marked decidual reaction in the stroma, as a rule, and this is easily mistaken for an early abortion. The presence of trophoblasts and chorionic villi is the decisive point in the differentiation of these two conditions. The differentiation from ectopic pregnancy is very difficult and usually has to be made from the history and clinical examination. Fig. 683 shows the microscopic characteristics of the expelled membrane. Fig. 684 shows a remarkable membranous cast which not only outlines the endometrial and cervical cavities but has portions also from the tubal cavities.
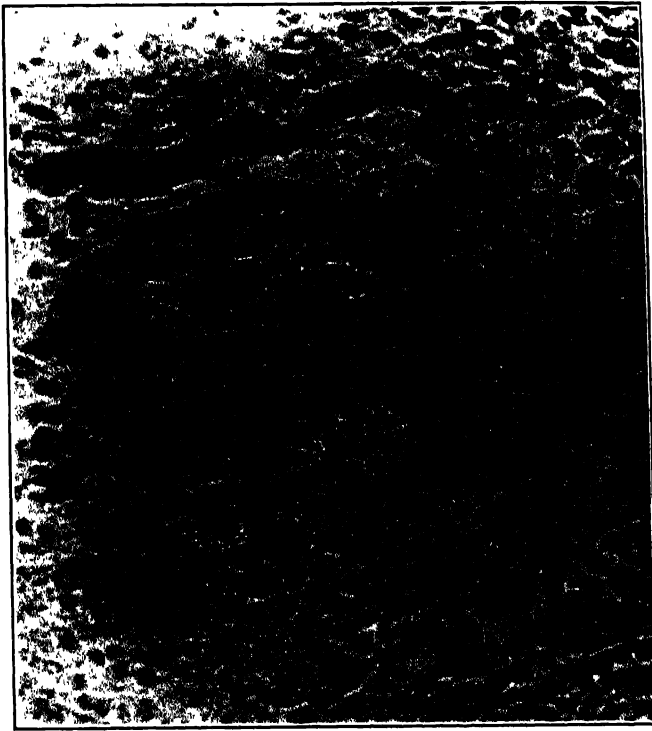
Fig. 683.—Membranous dysmenorrhea. Note the gland in the upper left corner showing beginning disintegration and the ghostlike remains of a gland in the right lower portion of the figure, with its edematous lining cells. Gyn. Lab.

Fig. 684.—Photograph of a remarkable specimen consisting of a membranous cast of the endometrial cavity with cervical and tubal extensions. (The constriction at the upper part of the endometrial portion was produced by string used in mounting.) (Williams—*Am. J. Obst. & Gynec.*)

Diagnosis

In married women membranous dysmenorrhea must be distinguished from early abortion and extrauterine pregnancy, in both of which conditions there may be bloody discharge, with much pain and the passage of shreds of membrane. If this happens to take place near the menstrual time, the patient naturally supposes it is simply a menstruation somewhat delayed. In membranous dysmenorrhea there is usually a history of the expulsion of membrane at several menstrual periods, whereas with abortion there is the history of a missed menstruation and of morning sickness. Also the blood clots are much more-numerous in abortion, and with the membrane can usually be found a small sac and embryo. The bleeding from abortion persists indefinitely until

the uterus is emptied, whereas in membranous dysmenorrhea it lasts only about the usual menstrual time. Microscopic examination of an expelled membrane or of shreds removed by curettage in abortion shows chorionic villi. In extrauterine pregnancy there is no previous history of membranous dysmenorrhea and the patient, previously regular, has now gone overtime for one or more weeks. The pain is due to intraperitoneal bleeding, of which it presents the characteristics.

Treatment

The treatment is symptomatic for the pain, and otherwise is largely for complicating or associated conditions. As to curative treatment directed to overcoming the local disturbance of metabolism, endocrine and general nutritional measures are to be considered. Curettage may assist by improving the local nutrition and by overcoming any cervical stenosis which aggravates the painful expulsive uterine contractions.

Some years ago, Lawrence called attention to its frequent association with tubal inflammation, and reported 42 cases of membranous dysmenorrhea in which there was present tubal or ovarian disease requiring operation. In 19 cases the disease was unilateral and in the remaining ones bilateral. In 33 of the 42 cases the trouble appeared, from the history, to have started from an attack of scarlatina, measles, mumps, rheumatism, or smallpox. In nearly all (the report is not definite) there was no further membranous dysmenorrhea after the removal of the pelvic disease. He concludes that membranous dysmenorrhea is due to trophic changes in the endometrium secondary to adnexal disease, and that this adnexal disease is usually a sequela of one of the exanthemas occurring near puberty. He concludes also that the adnexal disease is usually unilateral at first and may be prevented from extending to the other side by prompt attention. As a result of these conclusions, he holds (a) that tubal and ovarian complications occurring with the exanthemas near puberty should be watched for and treated, (b) that in every case of membranous dysmenorrhea a careful history should be obtained with that point in view, (c) that when unilateral adnexal disease is found, prompt operation should be carried out to prevent the trouble becoming bilateral.

ACUTE ENDOMETRITIS

Acute endometritis is acute inflammation due to bacterial invasion of the endometrium and adjacent tissues. Metritis and endometritis in the recently pregnant uterus (puerperal sepsis) are obstetric subjects.

Etiology and Pathology

Nonpuerperal acute metritis is usually due to infection with the gonococcus, as ordinarily this is the only germ that will, on mere contact, implant itself and grow and spread upward in the nonpuerperal genital tract. Gonorrhea involves the cervix in a large proportion of the cases of vaginal gonorrhea. Its extension upward from the cervix to the endometrium may be spontaneous or induced. Spontaneous extension upward may take place immediately following the infection of the cervical mucosa, or the inflammation may remain limited to the cervix for weeks and months, with the possibility of the extension upward at any time. During or immediately following the menstrual flow is the favorite time for the progress upward of the gonococci.

Infection of the endometrium with other inflammatory bacteria (staphylococcus, streptococcus, colon bacillus, etc.) is usually due to sounding the uterus or other intrauterine instrumentation, the germs being carried in from outside the body or from the vagina or from the cervical canal. Endometritis so caused was rather frequent formerly when the uterine sound was passed by touch, but not so now, since the uterus is not so often sounded, and when it is sounded care is taken to do the sounding in an aseptic way.

While extension upward of ordinary pus germs without the intervention of pregnancy or instrumentation is a rare occurrence in the period of functional activity and normal tissue resistance, it occurs more frequently before puberty and after the menopause. Several cases of fatal peritonitis in children from extension upward of streptococci have been reported.

Symptoms and Diagnosis

In the gonorrheal cases, after the vaginitis or cervicitis has continued a few days or several weeks, as the case may be, the patient complains of ''cramps'' in the lower abdomen and of soreness in the pelvis when walking, and of increased vaginal discharge. Sometimes the pain is quite severe and occasionally the patient is confined to bed for a few days. There may be moderate fever (101° to 102° F.), but the fever is rarely marked as in puerperal endometritis. By close questioning, we can usually obtain a history of symptoms indicating gonorrhea within the last few weeks or months.

If there is any discharge from the cervix or urethra or vulvovaginal glands, spread preparations are made on slides, which can later be stained and examined for the gonococcus. In the form due to ordinary pus bacteria, the symptoms are about the same, with a history of preceding labor or miscarriage or intrauterine instrumentation.

Digital and bimanual examination show that the body of the uterus is tender on pressure. If the disease is still limited to the uterus, there will be no decided tenderness outside the organ. If the trouble has extended to the adnexa, there will be marked tenderness and perhaps a mass about the tube involved. Through the speculum, the mucopurulent discharge may be seen coming from the cervix.

Treatment

The patient should be put to bed, if not there already, and kept at rest until all acute symptoms subside, with the hope of checking the process before it extends to the tubes. Prompt chemotherapy with the sulfonamides, as outlined under gonorrhea, gives the best chance of stopping the process. Local heat or cold application may relieve local pain, or a mild sedative may be required. Lactic acid douches and tablets to restore normal vaginal pH, as detailed under Vaginitis in Chapter IV, will remove the purulent discharge and minimize vaginal irritation.

CHRONIC ENDOMETRITIS AND METRITIS

Chronic endometritis is inflammation of the endometrium due to bacterial invasion. It is not nearly as common as was formerly supposed, when the term was used to cover most of the pathologic conditions of the endometrium and

some of the physiologic.   Bacteriologic investigations have shown that it is comparatively infrequent.   This relative immunity of the endometrium to chronic inflammation has been ascribed to the fact that it is regularly desquamated at periods, thus tending to cast off any infective agent present.   When present it is usually associated with chronic inflammation of the cervix or tubes, due to the original infection, and the important continuing uterine lesion is metritis involving the muscular wall.

Fig. 685.—Chronic metritis.   Thickness of entire wall 20 mm. (myometrium 18 mm., endometrium 2 mm.).   The thickening is moderate but is due entirely to round cell infiltration and increased fibrous tissue.   Gyn. Lab   (Schwarz—*Am. J. Obst.*)
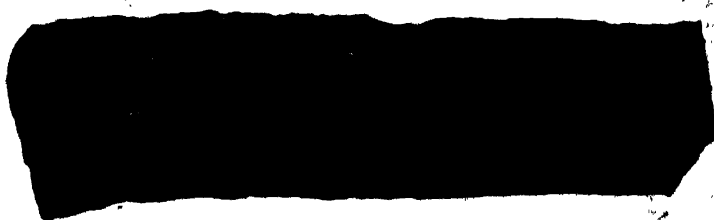
A.
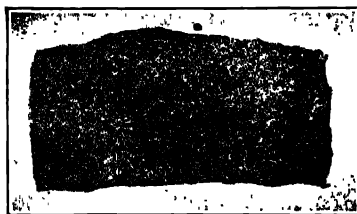
B.

Fig. 686.—Uterine wall from a case of chronic metritis (*A*) contrasted in thickness with a normal wall (*B*), the two being magnified alike.   In this case the entire wall was 31 mm. thick (myometrium 30 mm., endometrium 1 mm.).   The thickness of the wall is from changes due to chronic inflammation.   Gyn. Lab.

Pathology

The gross characteristics are shown in Figs. 685 and 686.   In the early stages the uterus is large, soft, and boggy, but later it may decrease in size and become very firm.   The small sclerotic uterus is of this type.

The microscopic details of chronic endometritis are shown in Fig. 687, the distinguishing feature being the extensive round-cell infiltration composed chiefly

of plasma cells. The plasma cells indicate chronic inflammation, and they are identified by the fragmented nucleus eccentrically placed, shown to some extent in Fig. 687, *B* but shown better (higher magnification) in a section from a tube (Fig. 881).

The microscopic details of chronic metritis are shown in Figs. 688 and 689. Old inflammatory infiltration is present with the characteristic perivascular distribution (Fig. 688), and also a marked increase in connective tissue, especially in the outer third of the wall (Fig. 689, *B*). Puerperal metritis tends to cause

A.   B.
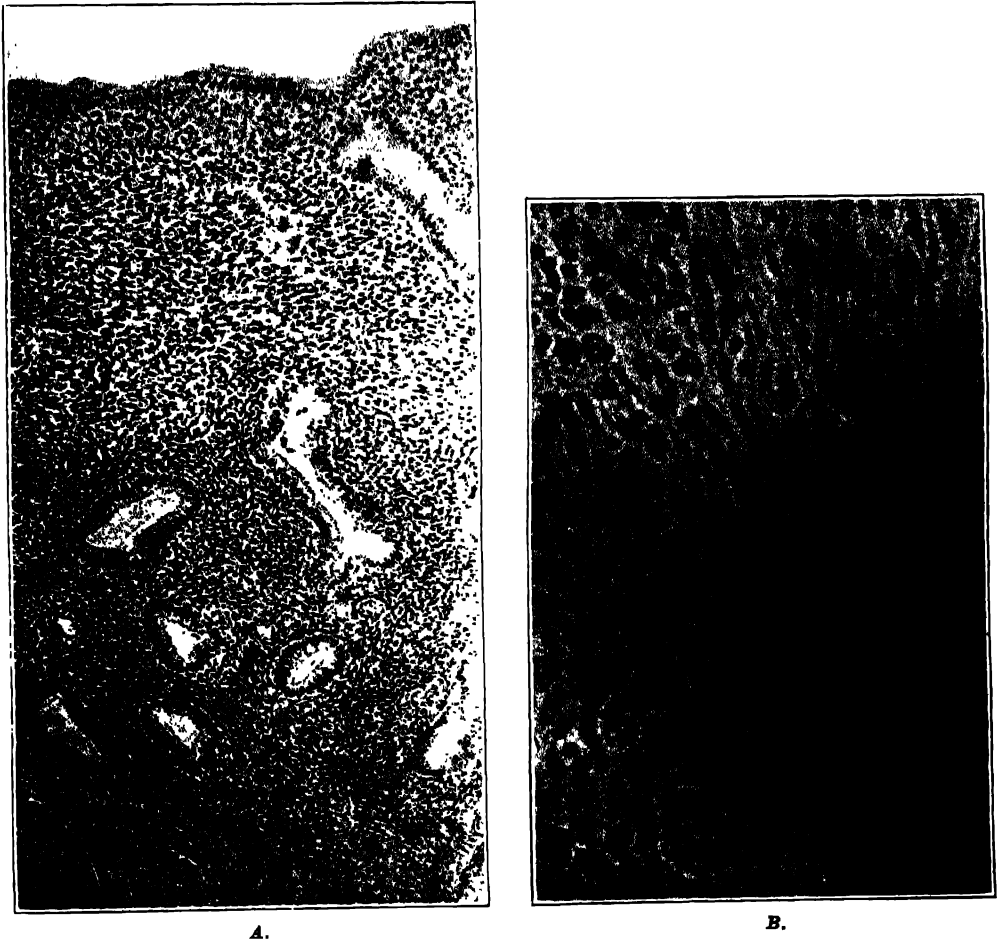
Fig. 687.—Chronic endometritis. *A,* Notice the foci of round cell infiltration. The glands are practically normal—none of the dilatation and bizarre shapes seen in hyperplasia. *B,* High power of one of the foci in *A.* The infiltration is composed chiefly of small round cells and plasma cells. The plasma cells are seen as rather large cells with a more or less fragmented nucleus eccentrically placed. The characteristic details of plasma cells are better shown in Fig. 881. Gyn. Lab.

subinvolution and hence the two conditions are often found in later sections, but fortunately for a clear picture there is no complicating subinvolution in the sections shown here, the elastic tissue being practically normal and showing none of the degeneration and diffusion characteristic of subinvolution (compare with Figs. 692, 693).
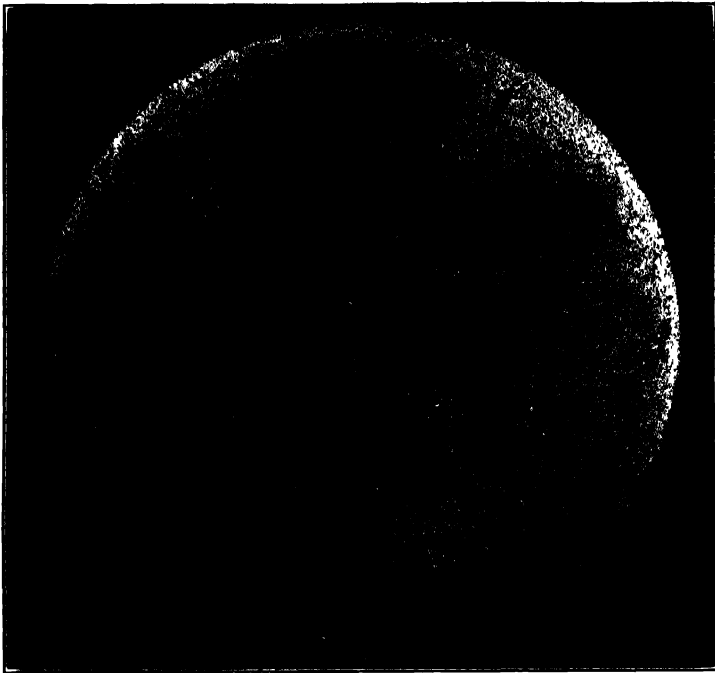
Fig. 688.—Chronic metritis. H & E stain, showing marked round cell infiltration in the myometrium. Gyn. Lab. (Schwarz—*Am. J. Obst.*)
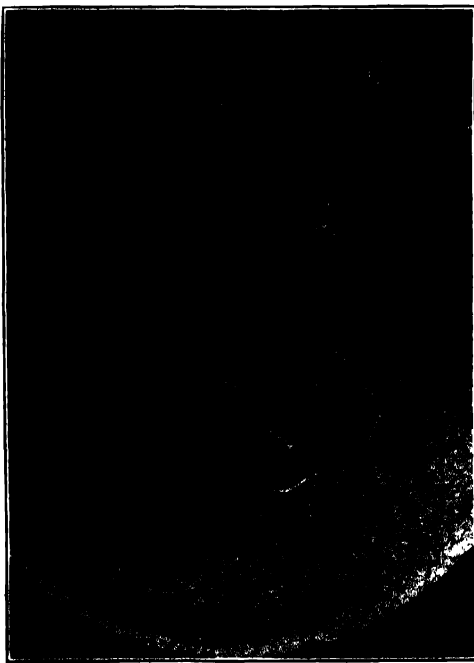
A.   *B.*

Fig. 689.—*A*, Chronic metritis, middle third. Weigert-van Gieson stain, showing connective tissue increase and the absence of diffused elastic tissue. The connective tissue forms the rather dark network about the lighter staining muscle bundles. Notice the normal distribution of elastic tissue as a fine elastic intima inside the vessel near the center of the field. *B*, Chronic metritis, outer third. Weigert-van Gieson stain, showing increased connective tissue, but without diffused degenerated black-staining elastic substance characteristic of subinvolution. Compare this photomicrograph with the one from a similar portion of the wall in a case of subinvolution, Fig. 788, *B*. The two are stained with the same stain. Gyn. Lab. (Schwarz—*Am. J. Obst.*)

Symptoms and Diagnosis

The patient comes complaining of a vaginal discharge (leucorrhea) which she has had for several months or years. This may be free and troublesome or very slight, and it may be the only symptom. Usually, however, there are menstrual disturbances—painful menstruation, increased menstrual flow, and irregular menstruation. The menses may last a week or ten days, and bleeding between times may appear. Hemorrhage is especially marked when there is an associated hyperplasia or polypoid condition of the endometrium. On the other hand, if the metritis has advanced to the stage of shrinking from scar-tissue formation in the wall, the menstrual flow may be scanty and painful and bimanual examination shows a small sclerotic hypersensitive uterus, the so-called "irritable uterus."

Treatment

Vigorous endocrine treatment may relieve the subjective disturbances some, though not much organic change can be expected in a sclerotic uterus. Otherwise treatment is symptomatic. If there is discharge and excessive menstrual flow in spite of medication, curettage may be indicated as a therapeutic measure, and it may be required before that as a diagnostic measure to exclude cancer. When, in spite of other measures, there continues a persistently hypersensitive and disabling uterus, hysterectomy may be required to give relief.

SUBINVOLUTION OF UTERUS

Subinvolution is the term applied to that condition of the uterus found in cases in which, after labor or abortion, it fails to return to its normal size. It remains large and heavy, and its walls are greatly thickened (Figs. 690, 691).

Etiology

As mentioned at the beginning of this chapter, there is a group of organic disorders of the uterus which has occasioned considerable difficulty in classification because not due to the commonly recognized causes of structural change, such as infection, traumatism, tumor formation, or developmental defect.

On consideration it is evident that each of these disorders is due to some marked disturbance in the local metabolism—so marked as to produce structural change. This furnishes a basis for group designation, and also indicates the direction in which to look for the underlying etiologic factor. This group includes subinvolution of the uterus, hyperinvolution of the uterus, hyperplasia of the endometrium, and hypertrophy of the myometrium.

Subinvolution is due to some interference with the retrograde changes that normally follow labor. These retrograde changes that normally take place consist of atrophy of the muscular and connective tissue. Fatty degeneration, which was formerly supposed to occupy such a prominent place in the process, has been found to be a subordinate feature. The retrograde changes may be interfered with by anything that prevents proper contraction and retraction of the uterus or that causes chronic congestion.

A uterus which becomes infected after labor does not return to its normal size unless the infection is overcome. Retained membranes or placental rem-

nants also interfere with the process of involution, even without infection. General diseases, producing an impoverished condition of the blood may, following labor, so interfere with the nutrition of the uterus as to cause subinvolution. Retrodisplacement of the uterus after labor or abortion is a factor in subinvolution, which is favored by anything which interferes with the circulation or the

Fig. 690.—Subinvolution of the uterus. Gross specimen, showing marked thickening of the uterine wall and numerous large thickened projecting vessels. Gyn. Lab. (Schwarz—*Am. J. Obst.*)
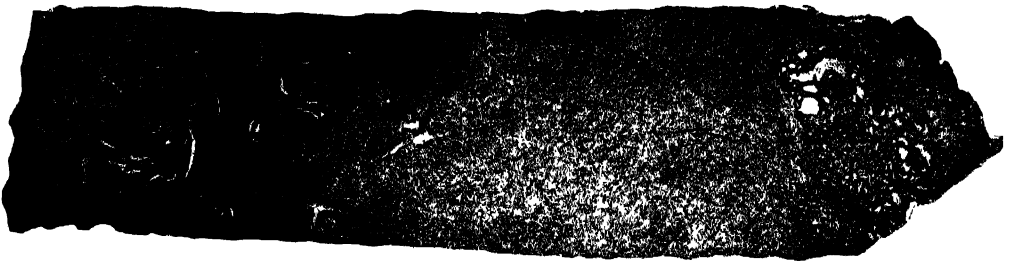
A.
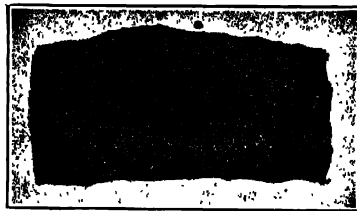
B.

Fig. 691.—Uterine wall from a case of chronic subinvolution (A) contrasted in thickness with a normal wall (B), both being magnified to about the same extent. In this case of subinvolution the uterine wall was 40 mm. thick (myometrium 31 mm., endometrium 9 mm.). The thickness of the wall is due chiefly to subinvolution abnormalities of vessels and muscle and connective tissue. Gyn. Lab.

metabolic processes by which waste products are removed and nutriment supplied to the elements of the uterine wall. The uterine-contraction stimulus furnished by nursing is probably a factor in normal involution, and its absence a factor in subinvolution.

Pathology, Symptoms, Diagnosis

Subinvolution is, at best, a relative term, for every parous uterus shows some evidence of "subinvolution." There is never a complete restitution to the virginal uterus. With succeeding pregnancies there is an increasing amount of connective tissue deposited, while the blood vessels seldom regress to their former condition.

In typical subinvolution the uterus is enlarged to a varying degree (Figs. 690, 691). On section the musculature appears coarse and the blood vessels stand out above the surface (Fig. 690). Microscopically there may be a preponderance of connective tissue, and there is usually some lack of uniformity, the involution being more advanced in some parts than in others. The endometrium may or may not be thickened.

The most characteristic microscopic pathologic changes are seen in the blood vessels and are explained and illustrated in Figs. 692 to 694. In normal involution the enlarged vessels are partially or completely obliterated by an increase in the elastic tissue fibers of the intima and media. This tissue then becomes hyaline and is absorbed. In subinvolution the process may be halted at any stage, giving rise to vessels with immensely thickened walls and often very irregular shapes. The great thickening in the vessels is due largely to the remaining unabsorbed elastic tissue.

The symptoms of subinvolution are simply a sense of weight and pressure and weakness in the pelvis, with menstrual disturbances (usually increased flow). As a rule, the most prominent symptoms are those due to complications, such as hyperplastic endometrium, infected metritis or retrodisplacement. In practically all cases of infection following labor or abortion there is more or less subinvolution.

The enlarged uterus is usually found low in the pelvis and not particularly tender, unless there is a complicating metritis. The uterus may be retroverted, and there is often laceration of the pelvic floor. The history connects the trouble with a previous labor or miscarriage.

Prophylaxis of Subinvolution

Subinvolution is one of those diseases which may, in a measure, be anticipated and often prevented. The measures to be employed in the puerperium to avoid subinvolution are as follows:

1. Prevent infection following labor or abortion by careful attention to asepsis.

2. See that the uterus is emptied of placental remnants and membranes.

3. Repair all lacerations of the pelvic floor. Unrepaired lacerations of the cervix also favor infection and subinvolution.

4. Keep the uterus fairly well contracted. If it shows a tendency to remain unduly relaxed during the puerperium, tone it up by proper medication.

5. Prevent retrodisplacement of the heavy puerperal uterus and improve its circulation by the routine use of the knee-chest posture at the proper time in postpartum care. As explained under knee-chest posture in Chapter III,
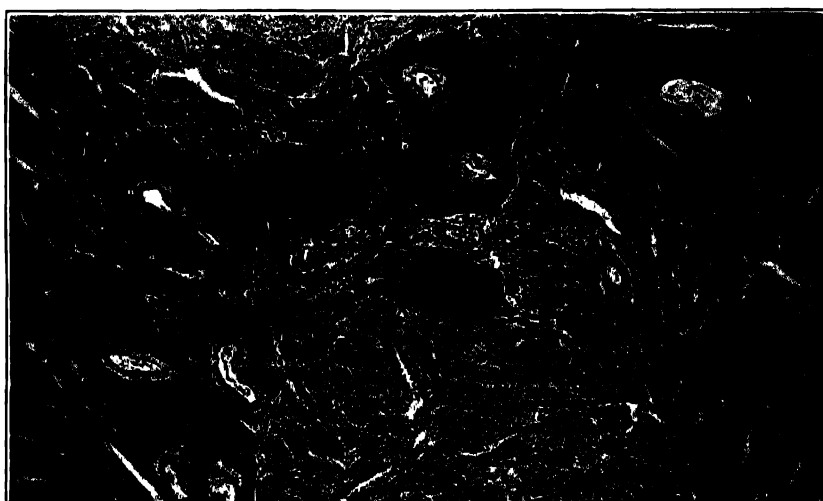
Fig. 692.—Subinvolution. Weigert-van Gieson stain. Vessels of the inner third of uterine wall. The old subinvoluted vessels are seen staining as black collars around the new smaller vessels which have come up into the lumen of these old degenerated ones. On account of a block in the absorption of these old vessels there remains diffused degenerated elastic tissue, which retains the power of staining black with Weigert's stain. Gyn. Lab. (Schwarz—*Am. J. Obst.*)
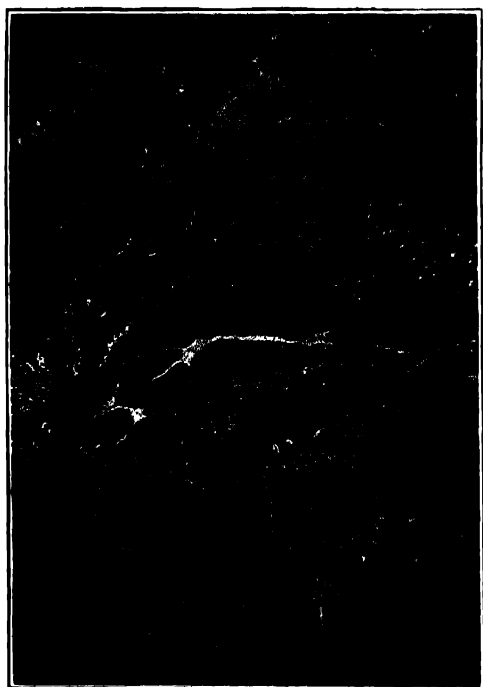
Fig. 693.

Fig. 694.

Figs. 693 and 694.—Subinvolution. Weigert-van Gieson stain. Fig. 693, Vein of middle third of uterine wall. The black staining shows that the unabsorbed degenerated elastic tissue has diffused through most of the vessel wall, a condition characteristic of subinvolution. Fig. 694, Outer third of uterine wall, showing the amount of diffuse dead elastic tissue between the muscle bundles, due to lack of absorption of this degenerated material during the process of involution. Gyn. Lab. (Schwarz—*Am. J. Obst.*)

there is danger in employing it in the early postpartum period, when reliance should be placed on having the patient lie on the abdomen or side. But by four to six weeks postpartum, the reparative processes have advanced so that the knee-chest posture may be added safely and with decided benefit to the position of the uterus and to the pelvic circulation.

This point of prophylaxis by correction of retrodisplacement is strongly emphasized by O. H. Schwarz, who made a special study of subinvolution, confirmed the work of Fletcher Shaw in regard to elastic tissue diffusion, as beautifully shown in Figs. 692 and 693, and contributed several instructive articles as indicated in the Reference List.

6. Lessen pelvic congestion by overcoming constipation, removing any irritating discharge with douches, prescribing periods of rest during convalescence and continuing the knee-chest posture as long as there is any tendency to retrodisplacement.

Treatment

The principal disturbances accompanying subinvolution come from the associated diseases; consequently the treatment is directed largely to the associated conditions. The following measures tend to tone up and improve the condition of the uterine wall:

1. Improve local tissue nutrition and circulation by building up general health with vitamins, endocrines, and other indicated medication.

2. Curettage is the most effective local measure for influencing the circulation and nutrition of the uterine wall. Curettage should be followed by the other remedial measures, such as douches, laxatives, uterine astringents internally, and local measures indicated. Treatment for cervicitis, restoration of pelvic floor support or operation for uterine prolapse or retrodisplacement may be required.

HYPERINVOLUTION OF UTERUS

Hyperinvolution is a very rare condition in which the process of involution following labor does not stop at the normal limit, but continues until the uterus is much reduced in size. The uterus sometimes becomes so small as to measure only an inch in depth. The cause of this trouble is deficient ovarian function. Obviously the condition in its more aggravated form is associated with amenorrhea.

Some years ago the senior author saw an interesting case of hyperinvolution of the uterus and adnexa. The patient was thirty years of age. Three years previously she had had a severe infection following the birth of her child, and there had been no menstruation since. Pelvic examination showed the uterus to be very small. On account of other trouble it was necessary to open the abdomen, and thus the opportunity was given of inspecting the internal genital organs. All of them were atrophic—the ovaries, uterus, tubes, and round ligaments. The uterus was about half normal size.

Treatment. The hope of improvement lies in endocrine treatment. The striking results obtained with judicious use of endocrines (growth and estro-

genic) in underdeveloped uteri encourage the trial of such treatment for uteri which have receded from a former functioning condition. Kaufmann and also Clauberg have shown that an atrophic uterus may sometimes return to normal size under the use of estrogenic hormones.

HYPERTROPHY OF MYOMETRIUM

This condition consists of a uniform hyperplasia of the myometrium. The muscle fibers as well as the fibrous tissue take part in the hyperplasia. The diagnosis can be made only in uteri where previous inflammation and pregnancy can be excluded. There is no inflammation or subinvolution. There may or may not be an accompanying hyperplasia of the endometrium. The work of Kaufmann and of Clauberg, previously referred to, showing that atrophic
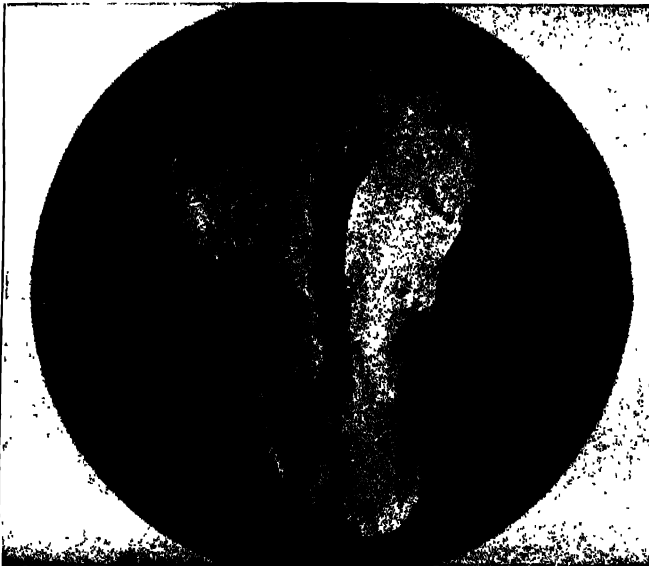
Fig. 695.—Hypertrophy of myometrium. Gross specimen from a nullipara, aged forty-one years. The endometrium is only 3 mm. in thickness and shows moderate hyperplasia. The myometrium is 19 mm. thick and the increased thickness is due entirely to hypertrophy of the muscle and connective tissues. Gyn. Lab. (Schwarz—*Am. J. Obst.*)

uteri can be made to return to normal size by use of the estrogenic hormones, would point to an excess of estrogen as one of the factors in hypertrophy.

The muscle fibers are the same as those found in a normal uterus with the exception that they are longer and a little larger. The vessels are numerous but contain none of the degenerated elastic material characteristic of subinvolution. A gross specimen of this rare condition is shown in Fig. 695, and the microscopic characteristics are shown in Figs. 696 and 697.

If the condition should cause disturbance, the treatment would be the same as for a troublesome uterus enlarged from subinvolution or metritis. In fact, the diagnosis of myometrial hypertrophy, instead of the more common causes of uterine enlargement, could be established only after removal and microscopic investigation of the enlarged uterus.

Fig. 696.—Hypertrophy of myometrium, with some hyperplasia of endometrium, from nullipara, aged nineteen years. No subinvolution and no infection (see Fig. 697). Thickness of wall 24 mm. (myometrium 19 mm. and endometrium 5 mm.). Gyn. Lab.
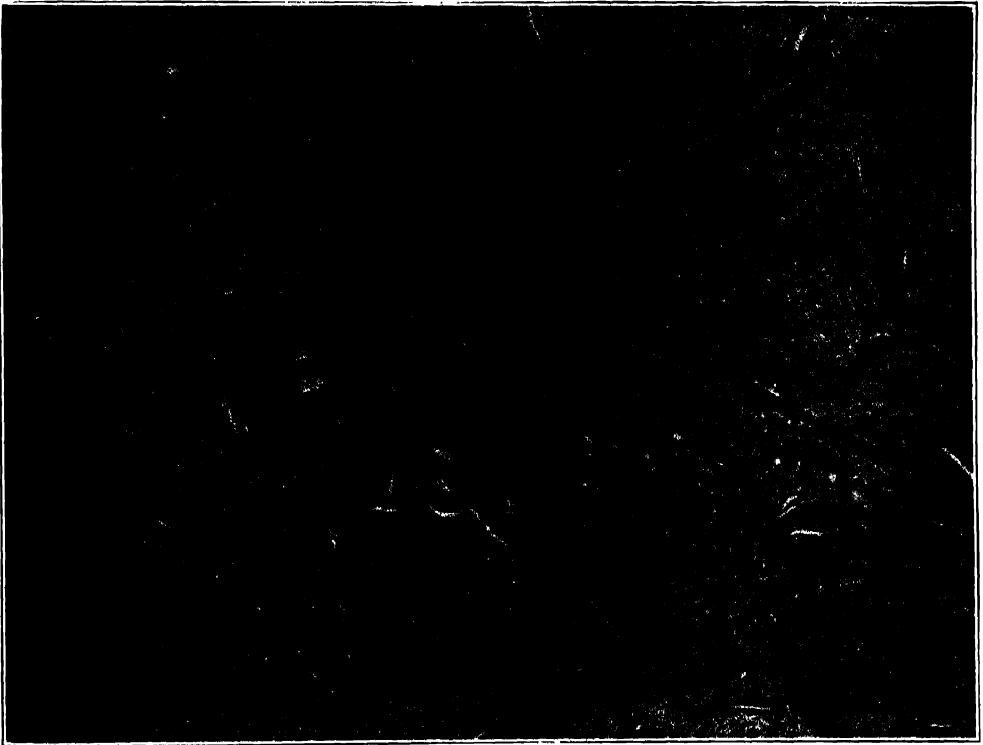
Fig. 697.—Hypertrophy of myometrium. High power of Fig. 696. Weigert-van Gieson stain, showing normal nulliparous distribution of elastic tissue, connective tissue, muscle tissue, and muscle. In the original, the elastic tissue is stained black and of course reproduces black in the photomicrograph. Notice the normal distribution as a thin, clear-cut elastic intima inside the blood vessels. The connective stains red and the muscle tissue yellow. The former reproduces as a rather dark network surrounding the lighter staining muscle bundles. Gyn. Lab.

SENILE ATRESIA OF UTERINE CANAL

In this condition, apparently largely nutritional, senile atrophy of the uterus with elimination of the endometrium continues to the point of atresia of the canal and obliteration of more or less of it. It is quite different from the inflammatory atresia found with pyometra, which may occur at any age and is rather frequent with advanced carcinoma.

The senile atresia here referred to presents no inflammatory symptoms or signs. The sides of the canal lose their protective mucosa at points of contact and the opposed surfaces adhere. As there are no symptoms, the process is of importance principally from the pathological standpoint. It is found occasionally at autopsy, usually in individuals of advanced age. It is encountered at times when endeavoring to dilate for curettage in an aged patient presenting some indication for intrauterine investigation.

It may be accompanied with cystic change in the thinned endometrium, in which case it is designated occlusive cystic atrophy ("endometritis atrophica cystica" of former times). Fig. 698 shows this condition in an autopsy specimen, with reproduction in exact size of the uterus and the cysts and the occluded portion of the canal.

Fig. 698.—Atrophic (senile) atresia of the uterine canal. This autopsy specimen from an aged woman presents also an unusual number of retention cysts from occlusion of atrophying endometrial glands. This condition was formerly designated "atrophic cystic endometritis," but we know now that inflammation, if present, is only incidental and that senile atrophy is the essential feature.

Knowledge of this occasional atrophic occlusion of the canal in the aged is important in interpreting the findings when an attempt at diagnostic curettage is blocked at the internal os. Gyn. Lab.

TUBERCULOSIS OF THE UTERUS

This term is applied to tuberculous disease of the uterine mucosa and myometrium. When the tuberculosis affects only the peritoneal coat of the uterus, it is classed as peritoneal tuberculosis.

Etiology and Pathology

Tuberculosis of the uterus usually comes from tuberculosis of the tubes. Occasionally it is due to infection from without, in which case it may come from tuberculosis of the external genitals.

It may be produced by coitus with a tuberculous husband, the tuberculosis in the husband being located in the genitourinary tract. It is possible for the infection to be carried in this way when the husband has only pulmonary tuberculosis, for tubercle bacilli have been demonstrated in the comparatively healthy testes and semen of phthisical patients. Infection conveyed

by coitus may be first manifested in the cervix or in the body of the uterus. It is held by some that such infection may be found first in the fallopian tubes. Tuberculosis of the uterus sometimes occurs as a part of a general infection, secondary to pulmonary tuberculosis.

Tuberculosis, unlike gonorrheal infection, usually descends from the tubes (Fig. 699) or even the peritoneal cavity. Tuberculosis of the uterus and cervix is, therefore, usually secondary to tuberculous salpingitis. It may, however, be blood borne. In the uterus it affects primarily the endometrium. It is found in about 50 per cent of patients with genital tuberculosis. This fact of probable uterine involvement should be kept in mind when extensive tubal tuberculosis is encountered in an operation.

Fig. 699.—Tuberculosis of the endometrium. Gross specimen, showing the thickened endometrium, and also the accompanying tubes which were tuberculous. From a white woman in whom a part of the right tube had been removed in a distant city some years before and found tuberculous. Notice the stump of right tube in the photograph of the specimen. Gyn. Lab.

In the stage of caseation it shows areas of caseous necrosis which may be confused with sarcoma or carcinoma of the endometrium. The differential diagnosis depends on microscopic examination.

Tuberculosis of the endometrium is easily diagnosed by finding tubercles and giant cells in the endometrium (Figs. 700, 701). The early cases have the tubercles in the stroma, but as these enlarge and become conglomerate and caseous, mass destruction of both glands and stroma occurs. Schroeder believes that the deeper layers become infected during menstruation.

Symptoms and Diagnosis

The symptoms of tuberculosis of the endometrium are principally those of a severe chronic endometritis. There is nothing particularly distinctive in the clinical evidences of tuberculous endometritis. A severe endometritis occurring in a virgin should arouse suspicion of tuberculosis. A persistent and severe chronic endometritis in the presence of peritoneal or tubal tuberculosis, or occurring in a patient with phthisis, is possibly tuberculous. The diagnosis is made by finding tubercle bacilli in the pus or finding characteristic changes in the scrapings from the uterus.
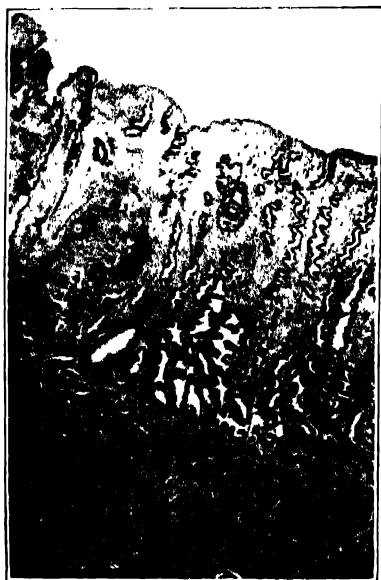
Fig. 700.   Fig. 701.

Fig. 700.—Tuberculosis of endometrium, low power. A tuberculous area in the endometrium is well shown.

Fig. 701.—Tuberculosis of endometrium. High power of a section from Fig. 700, showing typical tubercles and giant cells. Gyn. Lab.

Treatment

In all cases, general antituberculosis treatment is indicated. Tuberculosis of the lower part of the cervix alone calls for amputation of the cervix or hysterectomy. Tuberculosis of the body of the uterus indicates hysterectomy, provided there is no other involvement, e.g., advanced phthisis or very extensive peritoneal involvement. A moderate involvement of tubes and pelvic peritoneum is not a contraindication to operation, provided the patient is in a fair general condition. In cases in which the patient is not in fit condition for radical operation, or refuses it, the case is treated on the same general principles as chronic endo-

metritis, that is, by curettage, followed, if necessary, by antiseptic and astringent applications. Iodoform should be used freely, in powder or emulsion or as soluble bougies. While a cure may, in some cases, follow this mild treatment, its attainment is very uncertain, and owing to the impossibility of determining the limit of the uterine infiltration and owing also to the fact that the infiltration is very likely to spread in spite of all treatment, hysterectomy is the safer plan and the one to be advised in operable patients.

SYPHILIS OF THE UTERUS

In a most exhaustive monograph Gellhorn and Ehrenfest have presented the entire problem of the involvement of the internal female genitals by syphilitic infection. Our actual knowledge concerning the syphilitic lesions of the uterine body is extremely meager. Primary and secondary manifestations have not been observed in the uterus. There are a few instances on record of gumma in the uterine wall, also of a gummatous endometritis. This infrequency of tertiary lesions is rather a matter of surprise, for the uterus, more than any other internal organ of the body, is exposed to direct infection. Spirochetes may reach the endometrium from the vagina or from cervical lesions. Spirochetes, at least during pregnancy, undeniably circulate through the uterine wall as is proved by the fact that an actively syphilitic mother invariably infects the fetus in the uterus. Syphilis is a common cause of abortions.

The cervix is probably rather frequently the site of the primary chancre, but it is not likely to cause much discomfort and hence is seldom seen. Under Ulcer of Cervix in this chapter reference is made to a patient with an early syphilitic lesion of the cervix which had been mistaken for cancer and treated with radium. Of practical importance also is the fact that a tertiary gummatous nodule may develop in the cervix. The microscopic characteristics of the tissue changes in syphilitic lesions of the cervix are illustrated in Figs. 661 and 662.

ECHINOCOCCUS DISEASE OF UTERUS

Echinococcus disease affecting the uterus is a curiosity, and yet it is not so rare that it can be ignored in diagnosis. Undoubted cases have been reported in early life and in middle life and later. The liver is the organ usually affected in echinococcus disease. Many other organs, however, have been affected, with or without coincident affection of the liver, and among the organs occasionally affected is the uterus.

When echinococcus disease attacks the uterus (Fig. 702), there is nothing especially characteristic in the symptoms. The disease, at first, may resemble chronic endometritis with hemorrhagic tendency. As the cysts become larger, a tumor or several tumors become palpable, and the case may be considered one of uterine fibroids. When the masses become still larger, fluctuation may be detected or rupture into the uterine cavity may take place with the discharge of clear fluid and hooklets (Fig. 703) and daughter cysts. If rupture takes place into the peritoneal cavity, fatal peritonitis is probable. The process may stop at any stage and the lesion undergo partial absorption. Suppuration may take place in the lesion, forming abscesses. In some cases the symptoms resemble pregnancy, as mentioned by Reed, as follows:

"In cases of echinococcus infection of the uterine cavity, the symptoms may be essentially those of pregnancy. The uterus becomes enlarged and softened, the cervix presenting a bluish aspect. The womb enlarges, progressively and symmetrically, the breasts enlarge and may contain milk, while there are, not infrequently, reflex disturbances of the stomach. It is the occurrence of these symptoms which has generally caused infections of the uterine cavity by echinococcus to be looked upon as pregnancy, and the resulting cysts to be designated as degenerated ova. In practically all of these cases, however, the usual amenorrhea of pregnancy is absent, while the patient complains of more or less constant dribbling of blood from the uterus. While this is true, the fact must be recognized that infection of the uterine cavity may coexist with pregnancy, as was true in MacNeven's case, in which a large echinococcus cyst was expelled intact, during a true labor and immediately preceding the rupture of the amniotic sac. The exact diagnosis cannot be made without the demonstration of the hooklets."

Fig. 702.   Fig. 703.

Fig. 702.—Echinococcus disease of the uterus. Gross specimen showing an echinococcus cyst of the uterine wall. (Turenne—*Surg., Gynec. and Obst.*)
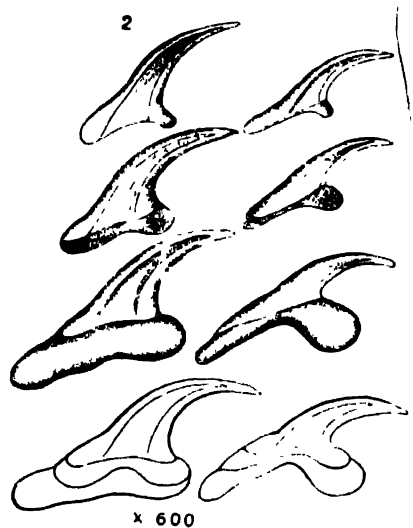
Fig. 703.—Echinococcus hooklets. The diagnosis of echinococcus disease depends upon finding these characteristic hooklets in the cyst fluid.

Echinococcus disease of the uterus must not be confounded with the more common "hydatidiform mole," in which small cysts of varying size are found, and may be expelled in a large mass. The two affections are entirely distinct. The first (echinococcus disease) is due only to the echinococcus parasite in the uterus, while the second (hydatidiform mole) is due to degenerative changes in fetal membranes—the chorionic villi proliferating and becoming distended with fluid so as to form a mass of little cysts.

The differential diagnosis between echinococcus disease and hydatidiform mole is made by microscopic examination of pathologic structures—hooklets being found in the first and chorionic villi in the second.

The treatment of echinococcus disease of the uterus consists in the rupture and continual drainage of all cyst cavities. If the disease persists and is not associated with some contraindicating lesion, hysterectomy is indicated.

NONMALIGNANT TUMORS OF THE UTERUS

Nonmalignant tumors of the uterus comprise myoma (including adenomyoma) and a miscellaneous group composed of other types, such as lipoma and the growths arising from remnants of the wolffian duct extending into the uterine wall.

MYOMA OF UTERUS

Myoma of the uterus is a tumor composed of muscular and fibrous tissue. It is often spoken of as uterine "fibromyoma" and as uterine "fibroid." As Mallory has pointed out, it is a true tumor of muscle tissue, and the term "myoma" is the accurate designation.

Uterine myoma occurs more frequently than any other tumor in women. Kolb found that it was present in 20 per cent of women over thirty-five years of age and in 50 per cent of all women over fifty years old. Gusserow found 38 per cent occurred between the ages of thirty and forty years.

Etiology

The persistent estrogenic stimulation of the uterus in the absence of pregnancy is supposed to be a factor in the causation of uterine myomas. The tumor is analogous to those growths which frequently enlarge the prostate in the male. The prostatic glands develop from the embryologic urethra and hence are not derived from muellerian tissue, but they grow out into the tissue at the junction of the muellerian duct with the urogenital sinus and part of this tissue is muellerian.

Myomas occur most frequently in middle life (period of sexual activity) though they may occur at any age. They are more frequent in the nonparous uterus. This is in marked contrast to carcinoma, particularly carcinoma of the cervix, which occurs almost exclusively in women who have borne children or had some other injury or irritation of the cervix.

The common association of hyperplasia of the endometrium with myoma would suggest excess estrin as the endocrine factor concerned. The work of Kaufmann and of Clauberg in causing small uteri in castrated women to grow to normal size by injections of large amounts of estrogenic hormone, is significant in respect to the excessive muscle growth in myoma. Nelson succeeded in producing multiple fibromyomas in 88 guinea pigs by long-continued injection of estrogens.

Cell Derivation.—Virchow believed that any muscle fiber in the uterus could, as a result of unknown stimulation, form a myoma. Ribbert's idea was that only certain fibers, which were not in complete growth-equilibrium, could form a myoma. Cohnheim championed the idea of embryonal rests as

the starting point for a myoma. The relation of certain early myomas to blood vessels has impressed many workers on this problem. This relationship suggests that the uterine myomas arise from disturbances in the growth of the embryonal blood vessels, from which the uterus and vagina originally derive their muscular tissue. Rosger, Kleinwachter, Sobotta, and others have traced the development of early myomas from blood vessels, and conclude that blood vessels control their origin and growth. According to Ewing, this idea has much to commend it, and he cites a case of his own in which there was striking evidence of the origin of the tumor masses from blood vessels. R. Meyer obtained specimens showing an uninterrupted transition from a normal muscle fiber to a myomatous fiber. Frankel believes that secondary
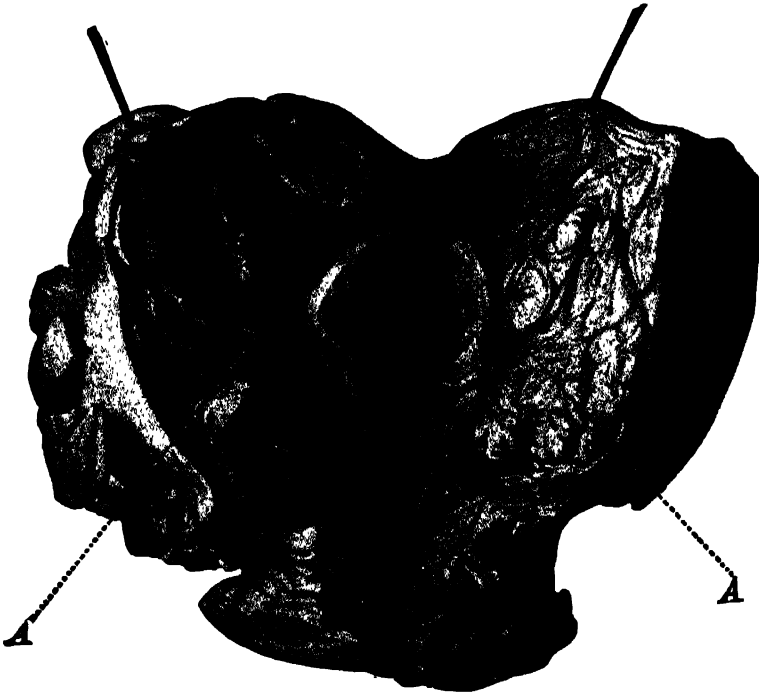
Fig. 704.—Multiple myomas of the uterus. *A*, The divided uterine cavity. Several of the myomas are approaching the peritoneum. (Bishop—*Uterine Fibromyomata.*)

myomas arise from daughter myoma cells in the middle layer of the capsule of the primary myoma, and stresses the importance of removing the entire capsule in order to prevent recurrence.

Histologically there are two type of myomas, namely, those composed of smooth fibers (leiomyoma), and those composed of striated muscle fibers (rhabdomyoma). The latter type is rarely found in the uterus.

Structure and Complications

Myoma may occur as a single growth or there may be many tumors in a uterus so affected, as shown in Fig. 704. The interesting clinical features will be taken up under five headings: structure, relation to uterine wall, adenomyoma (adenomyosis), secondary changes, and complications and associated diseases.

1. **Structure.**—The myoma is composed of interlacing bundles of involuntary muscle fibers in a network of connective tissue (Fig. 705), the same type of tissue composing the uterine wall. At the periphery of the growth the fibers are arranged in concentric layers. The adjacent muscle fibers of the uterus, which make up the outer layer of the capsule, are also arranged in the same fashion. The capsule (Figs. 706 to 709) consists of three layers, the two already mentioned and a third which lies between them and contains the vessels. It is from this central layer that the daughter myomas (Frankel) are supposed to arise.
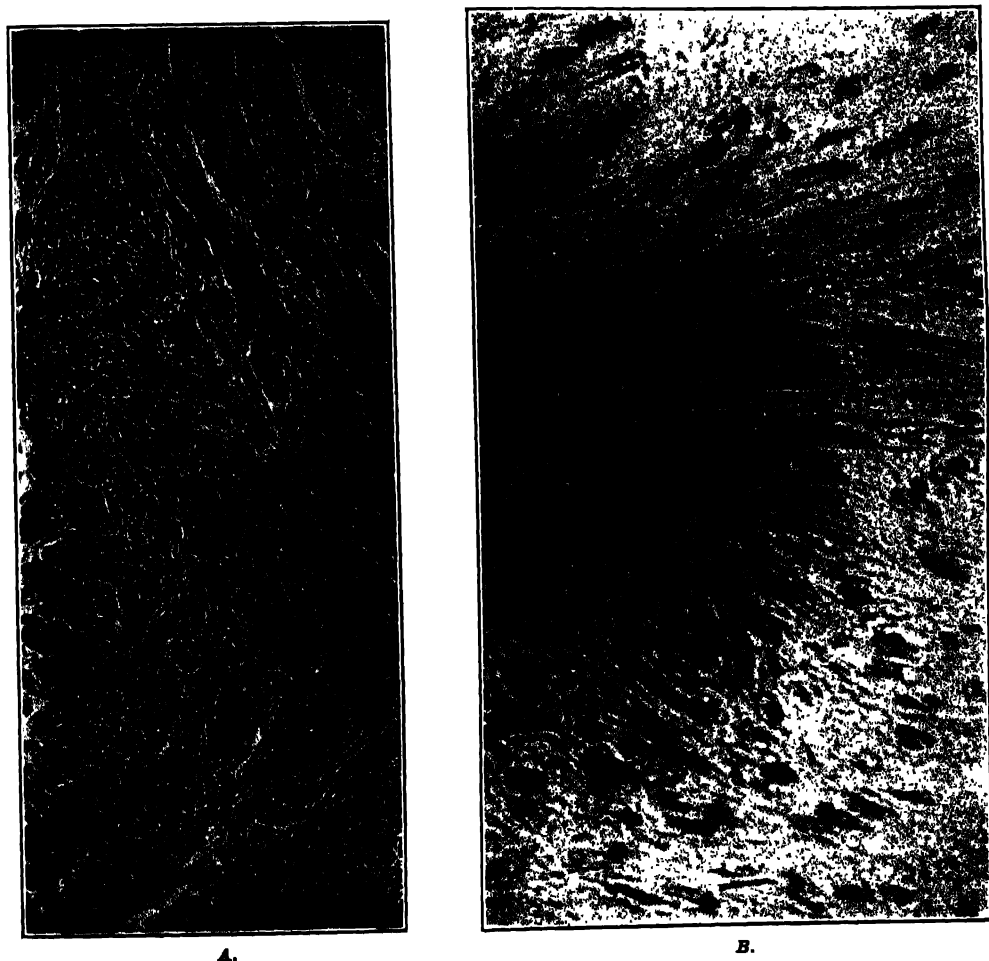
Fig. 705.—Microscopic structure of a myoma. *A*, Bundles of muscle fibers, extending in various directions. *B*, Higher power, showing muscle cells with rodlike nuclei. Gyn. Lab.

The muscle cells themselves are somewhat longer and narrower than the ordinary uterine muscle cells. Their nuclei stain deeper than normal cells, as does also their cytoplasm. Their nuclei are usually long and the ends are rounded when seen longitudinally, while on cross-section they are round or oval or crescentic. Between the muscle cells are myoglia fibrilles which extend beyond the cells and interlace with fibrilles of surrounding cells. The muscle

tissue stains yellow and the connective tissue red when the van Gieson method is used. The fibrous tissue cells can be seen separating the muscle tissue into bundles by the forming septa. Numerous elastic fibers are present in the older tumors.

2. **Relation to Uterine Wall.**—The myoma is nearly always encapsulated. It starts as a small nodule in the muscular layer of the uterine wall (Fig. 706). As it enlarges there usually develops a distinct capsule, or layer of condensed tissue, which separates the tumor proper from the normal uterine wall surrounding it as previously explained. From this capsule it may be easily shelled out, except when there has been inflammatory infiltration of the capsule and tumor.
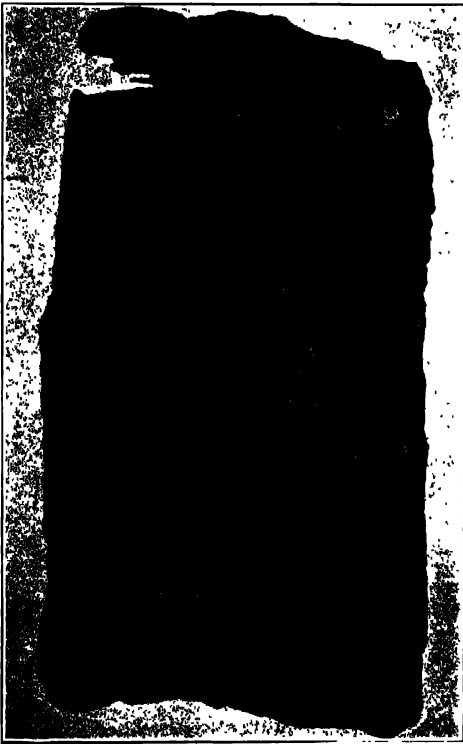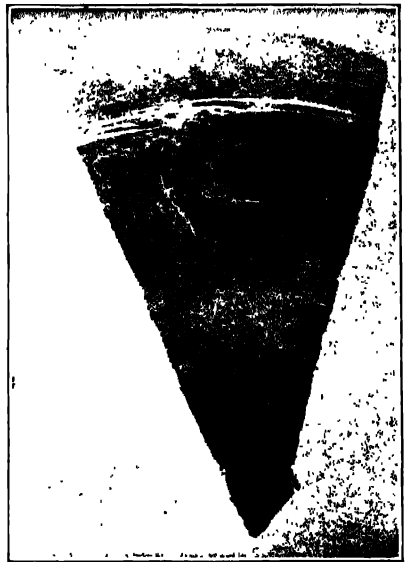
Fig. 706.   Fig. 707.

Fig. 706.—Photomicrograph of a small myoma, situated at about the middle of the uterine wall. The entire thickness of the wall is shown, the endometrium being at the left. The little tumor is distinctly encapsulated and has shrunken somewhat from the adjacent tissue, allowing the capsule to separate into layers. Notice the similarity in appearance of the tumor tissue and the tissue of the surrounding normal wall, due to the fact that they have the same elements and general structure.

Fig. 707.—The capsule of myoma. The layers of capsule have separated somewhat. Gyn. Lab.

As long as the tumor is surrounded by the muscular tissue of the wall, it is known as an **interstitial** or **intramural myoma**. They comprise from 60 to 70 per cent of the cases.

As the ordinary encapsulated tumor grows, it pushes in the direction of least resistance, stretching the muscular tissue around it and tending to push the muscular tissue aside. When it pushes aside the wall tissues and progresses toward the uterine cavity it may come in time to lie beneath the endometrium,

where it is known as a **submucous myoma** (Fig. 710). Submucous myomas comprise about 10 to 15 per cent of the cases. The proximity of the growth to the endometrium causes, in the latter, changes due to pressure. The glandular portion is narrowed, the surface epithelium flattened and missing entirely in some areas.

The submucous myoma may project farther and farther into the uterine cavity, until it is attached to the wall only by a pedicle, constituting a **pediculated submucous myoma** (Fig. 711). A pediculated submucous myoma may be forced into the cervical canal and later out into the vagina, as shown in Fig. 712. It may in this way cause partial inversion of the uterus, as indicated in Fig. 713, a fact that must be kept in mind when removing such a growth by vaginal excision. Occasionally the tumor will be forced outside the vagina, as in the case shown in Fig. 714.
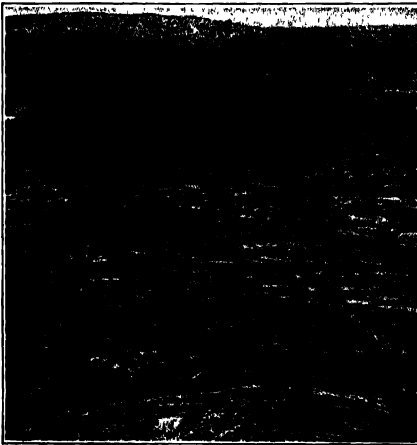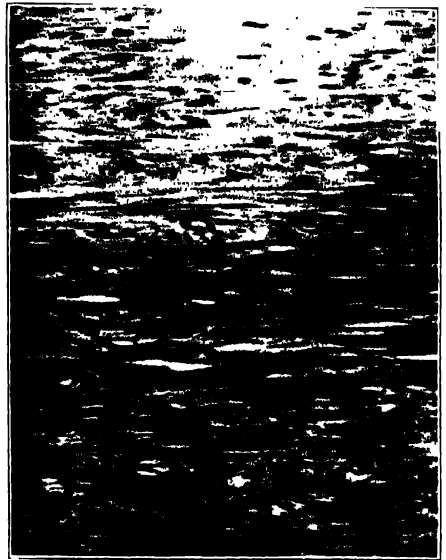
Fig. 708.   Fig. 709.

Fig. 708.—A view of an intact portion of the capsule shown in Fig. 707, under higher power. Notice the general longitudinal direction of the fiber bundles due to compression.

Fig. 709.—The same capsule, under still higher power, showing the general longitudinal direction of the individual fibers. Gyn. Lab.

On the other hand, if the myoma pushes outward as it develops it may come to lie just beneath the peritoneum, where it is known as a subserous or **subperitoneal myoma**. Several of these are shown in Fig. 704. They comprise from 20 to 30 per cent of the cases. This process of escape from the grasp of the muscular tissue may progress, the tumor projecting farther and farther beyond the outline of the uterus but still covered by the peritoneum, until it is attached to the uterus only by a comparatively narrow band of tissue, or pedicle, carrying the blood vessels and covered by peritoneum. It is then a **pediculated subperitoneal myoma** (Fig. 715).

.   In some cases adhesions to adjacent structures are formed, and through these adhesions the tumor may receive part of its blood supply. Occasionally

the pedicle of such a tumor is severed by torsion or otherwise, and the tumor is thus entirely separated from the uterus and receives its blood supply through the vascular adhesions. Such a tumor is known as a detached or "parasitic" or **wandering myoma,** and constitutes one of the curiosities of pathology. Many curious and instructive examples of parasitic myoma, as well as of all other types, are described and beautifully illustrated in that remarkable monograph by Cullen and Kelly, *Myomata of the Uterus.*

If a tumor which is escaping outward from the grasp of the muscular wall is so situated that it projects into the broad ligament, it is known as an **intraligamentary myoma.** If it projects in such a situation that it raises the peritoneum behind the uterus and passes back of the peritoneum, it is then called a **retroperitoneal myoma.**

Fig. 710.—A myomatous uterus laid open, showing submucous myomas encroaching on the uterine cavity and distorting it. Gyn. Lab.

The early stage of the myoma as an intramural or interstitial nodule, its gradual push toward the uterine cavity or toward the peritoneal surface as it grows, and the various relations to the uterine wall which it may occupy are summarized in Figs. 716 and 717.

Most myomas are found in the body of the uterus, as indicated in the various illustrations. In a certain proportion of cases the myoma is situated in the cervix. Bland-Sutton found in a series of 500 cases that 5 per cent were **cervix myomas.** These are more often single, and rarely project into

Fig. 711.

Fig. 712.

Fig. 711.—Two small myoma nodules in the uterine wall. There is also a polyp of the endometrium becoming pediculated, which is shown against the white paper slipped behind it.

Fig. 712.—A small pediculated myoma of the uterus, projecting into the vagina. (Montgomery—*Practical Gynecology.*)
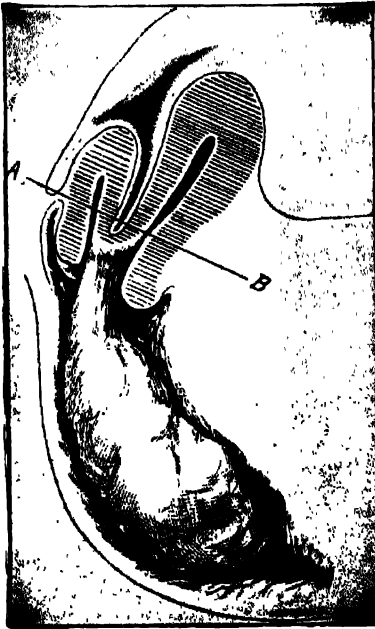
Fig. 713.

Fig. 714.

Fig. 713.—A pediculated myoma causing inversion of the uterus. This shows also a danger to be avoided in treatment. Amputation of the myoma by cutting across the pedicle at the level of the line *A-B*, would open the peritoneal cavity. (Thomas and Munde—*Diseases of Women.*)

Fig. 714.—A large pediculated myoma of the uterus, projecting outside the vagina. (Kelly—*Operative Gynecology.*)

the cavity, as the cervical cavity is small. They are usually comparatively small, but sometimes reach a size of eight pounds.

3. **Adenomyoma, Adenomyosis.**—In addition to the ordinary encapsulated myoma, there is a kind containing glands. These glands resemble the glands of the endometrium and are often surrounded or partly surrounded by a layer of endometrial stroma (Figs. 718, 719). The scattered islands of endometrial tissue exhibit the characteristic feature of the endometrium, that is, they men-
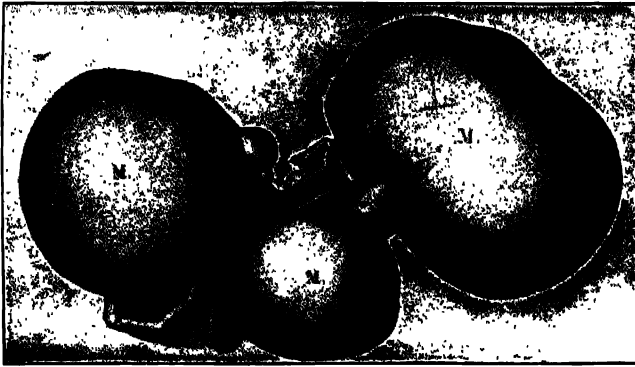
Fig. 715.—Subperitoneal myomas, showing the irregularity and distortion often present. (Kelly —*Operative Gynecology.*)
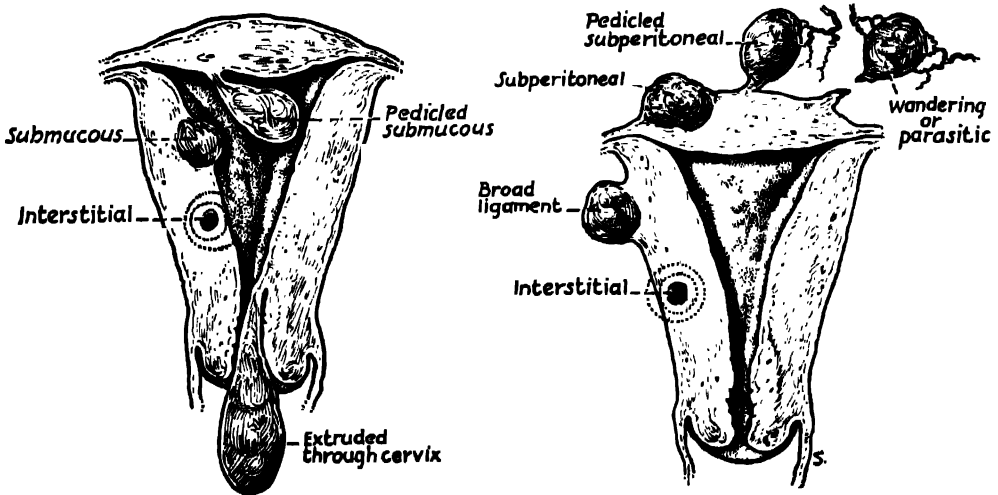
Fig. 716.

Fig. 717.

Fig. 716.—The development of different types of submucous myoma.
Fig. 717.—The development of different types of subperitoneal myoma.

struate. There being no exit for the menstrual blood, it accumulates in the closed glands, distending them and giving rise to much menstrual discomfort.

In its relation to the uterine wall the adenomyosis differs radically from the ordinary myoma. The gland growth is not encapsulated, as a rule, but penetrates the surrounding tissue in a way that makes separation very difficult. In the localized growths the margins fuse with the adjacent portions of the uterine wall, while some growths assume the form of a diffuse infiltration involving a smaller or larger part of the organ. Otherwise adenomyosis

bears the same relation to the wall as the ordinary myoma, i.e., tumors formed by the process may be interstitial, subperitoneal, pediculated subperitoneal, wandering submucous, and pediculated submucous. Extension of an adenomyoma to the surface of the uterus, or accompanying endometriosis, may form dense adhesions to adjacent organs.

The term "adenomyosis" is used as a general term for penetration of the uterine wall by endometrial glands, whether they come from the endometrium inside the uterus or from endometrial cysts of the ovary. The term "adenomyoma" is used to designate distinct tumor formation, which may, or may not, occur in the progress of adenomyosis. On the other hand, the process may be diffuse, as shown in Figs. 720 and 721 in which the endometrial glands penetrate the myometrium in all directions. In adenomyosis, epithelial elements in the form of gland tubules are scattered irregularly in the muscular tissue, and in these small closed cavities the endometrial elements menstruate at the menstrual time.
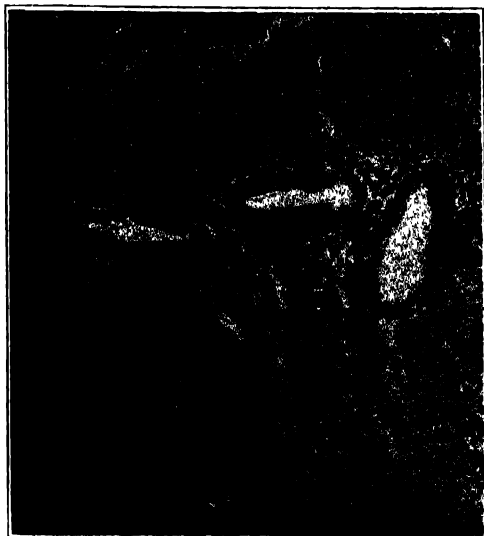
Fig. 718.

Fig. 719.

Fig. 718.—Showing typical glands in an adenomyoma. The specimen consisted of a very small subperitoneal myoma nodule, which was clipped off during the course of an abdominal operation without disturbing the uterus.
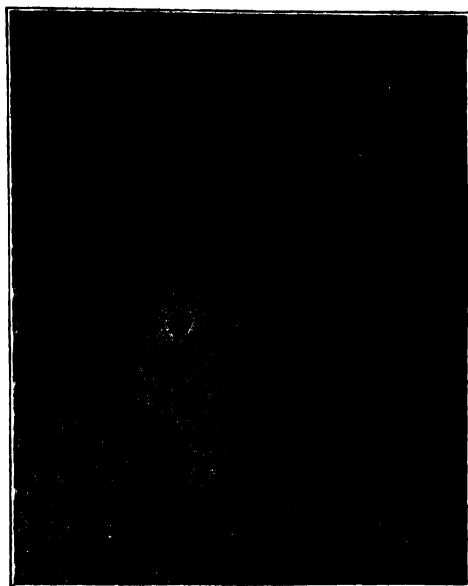
Fig. 719.—Higher magnification of a gland from the adenomyoma, showing the surrounding area of endometrial stroma. Gyn. Lab.

This blood accumulation in the closed gland tubes is a striking feature of adenomyosis, whether diffused or in the form of a local tumor (adenomyoma). Adenomyosis, diffuse or localized, is found in from 5 per cent to 6 per cent of myoma cases. It is found most frequently, according to Cullen, between the ages of thirty and sixty. The Mayo statistics show that 65 per cent of the married patients with adenomyosis had children.

There has been no satisfactory explanation as to why the endometrial glands invade the muscle. It is probable that after menstruation the remaining fundus of an endometrial gland grows a little deeper into the underlying muscle than usual and is pinched off from the overlying endometrium. Bits of endometrium may be carried deeply into the wall by the lymphatics or the veins, and then start to grow in the new location.

This extension outward of the glands into the uterine muscle area has been traced directly in a number of cases. Probably most of the cases of uterine adenomyosis arise in this way. The other method of origin is from ovarian endometrial cysts. The endometrial cyst forms adhesions to the uterus, and the endometrial tissue grows into the uterine wall

and thus starts an adenomyosis there. This method of origin accounts for those cases of adenomyosis at the peritoneal surface of the uterus entirely separate from any connection with the uterine endometrium.

The adhesions formed by adenomyosis are particularly serious, as these growths tend to infiltrate and fuse with adjacent structures. Adhesions thus formed with the rectum, bladder, and intestinal loops are very difficult of separation and constitute a serious menace in the operative treatment of adenomyomas, as they do in endometriosis.

Fig. 720.—Diffuse adenomyosis of uterus, gross specimen. The entire uterus shows thickening of the walls due to a coarse adenomyomatous growth, as shown in Fig. 721. Gyn. Lab.

4. Secondary Changes.—We have already given the primary structure of the different forms of myoma. In many cases there are found secondary changes in the tumor structure. Various types of degeneration occur. In fact,

it is unusual to find a large myoma without degeneration of some kind. Frankl believes that the cause for the frequent occurrence of degeneration in these growths is to be found in the course of the nutritive artery entering the myoma. He states that as the myoma grows it rotates in its capsule. This causes the artery, which formerly entered in a straight line, to be bent at a right angle

Fig. 721.—Section of the wall of specimen shown in Fig. 720. Notice the large gland areas extending through two-thirds of the wall. There is a peculiar coarseness of detail in these areas that causes the photomicrograph to resemble a drawing. Gyn. Lab.

Fig. 722.
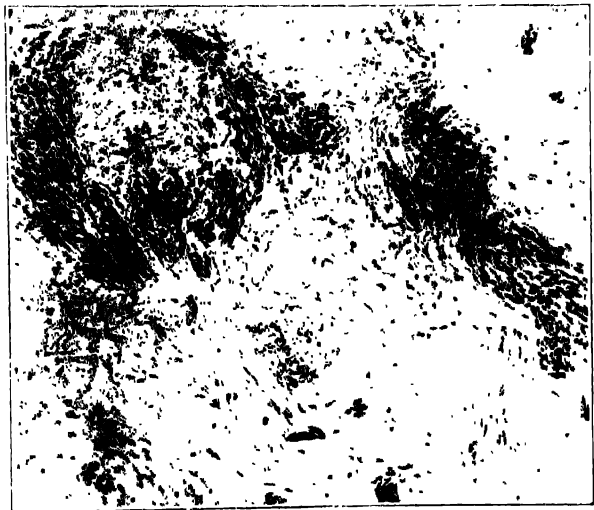
Fig. 723.

Figs. 722 and 723.—Hyaline degeneration in a myoma. Fig. 722, Low power. Fig. 723, High power. Gyn. Lab.

at two places—first, at the inner surface of the capsule, and second, where it enters the tumor proper. With these two likely points of compression it is not surprising that the nutrition to the growth is frequently impaired and that the degeneration usually starts at the center of the tumor.

The secondary changes found on detailed examination of removed myomas include edema from circulatory disturbance, hyaline degeneration, red degeneration (a circulatory disturbance principally associated with pregnancy), myxomatous (mucoid) degeneration, cystic formation, suppurative necrosis, calcification, sarcomatous degeneration, and other rarer changes (atrophy, fatty change, amyloid change).

Fig. 724.—A subperitoneal myoma showing an unusually large area of the white stage of necrobiotic degeneration. Drawing made from the fresh specimen, shortly after operation by the senior author. The color reproduction is accurate. The strange whiteness was very striking in contrast with the normally vascularized portion. The necrobiotic part was firm throughout and presented a fairly uniform appearance—no cavities nor malignant areas. Gyn. Lab.

MYOMA OF UTERUS
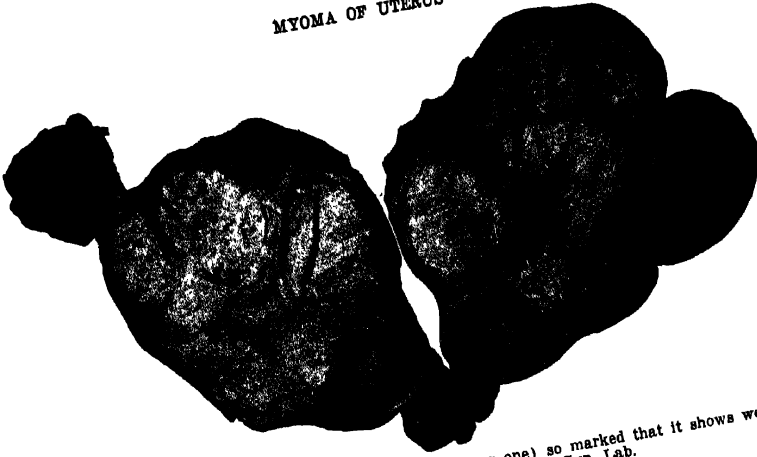
Fig. 725.—Red degeneration in a myoma nodule (lower one) so marked that it shows well in this ordinary photograph of the specimen. Gyn. Lab.

Fig. 726.—Red degeneration of a myoma. Drawing made from the fresh specimen shortly after removal by the authors. The tumor caused symmetrical enlargement of the uterus and was so soft that it gave perfect fluctuation. Examined after the abdomen was opened, the organ felt exactly like a pregnant uterus. However, the color of the peritoneal surface of the uterus had not the usual bluish tinge of pregnancy, and the record of persistent bleeding ruled out a normal pregnancy. Incision of the uterus revealed the condition shown above. The large, dark red mass was soft and edematous and much too large for the confining capsule of muscle wall. Notice how it bulges and rolls out over the sides. Gyn. Lab.

The frequency of secondary changes in myoma is indicated by an analysis of 1815 reported cases, consisting of nine series of consecutive cases in which degenerations were noted. In this combined series secondary changes of some kind were found in about 20 per cent of the cases. Malignant disease, as sarcomatous degeneration or associated carcinoma, was encountered in 3.6 per cent, suppuration in 5 per cent, necrosis from other causes in 4.7 per cent, cystic change in 3 per cent, and some calcification in about 2 per cent.
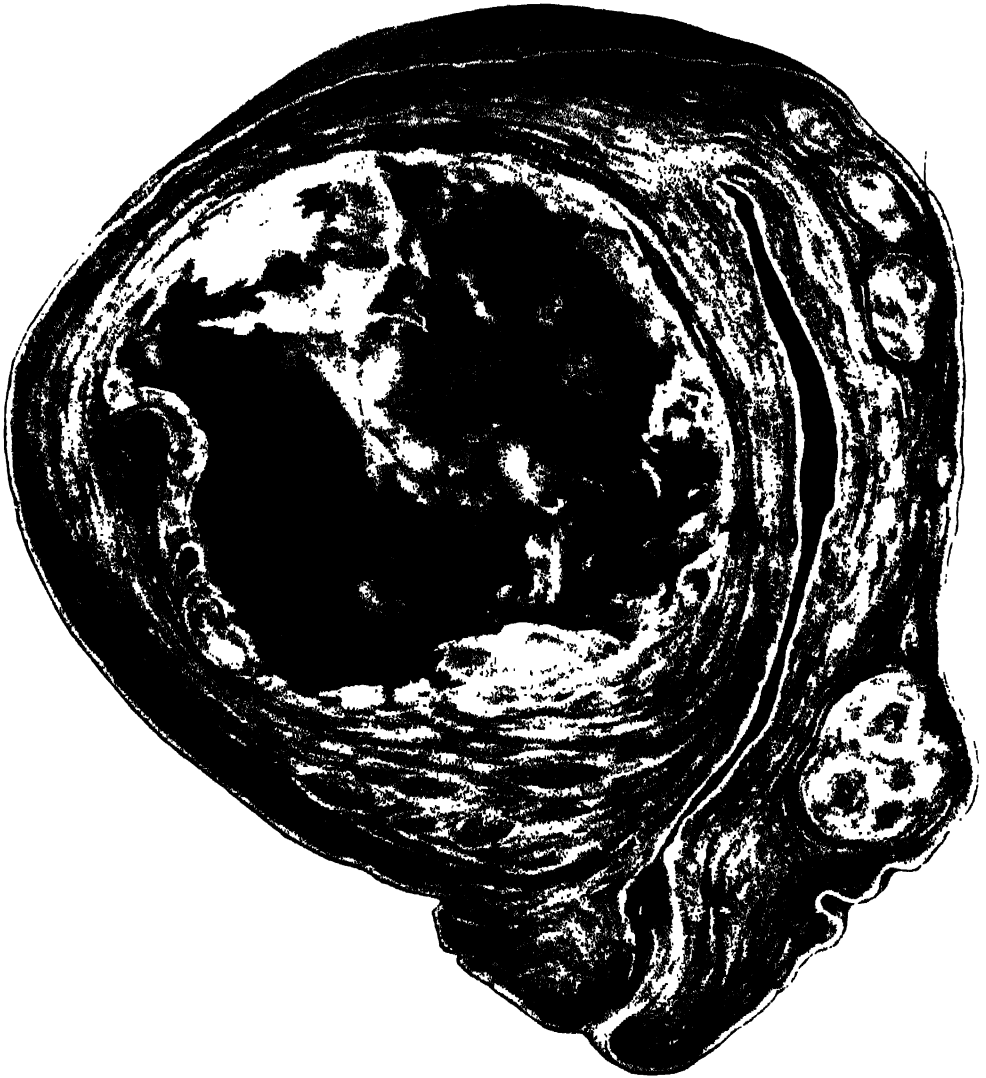
Fig. 727.—Cystic cavity forming in the largest of the numerous intramural nodules of a myomatous uterus.

A frequent type of secondary change is *hyaline degeneration*. This process may go on to liquefaction, and hence is one of the etiological factors in the formation of cystic areas in myomas. Such a liquefied and cystic spot, if large enough to be felt on examination as a soft area, may throw doubt on the diagnosis of myoma. If the soft area be small, the surrounding solid portion of the
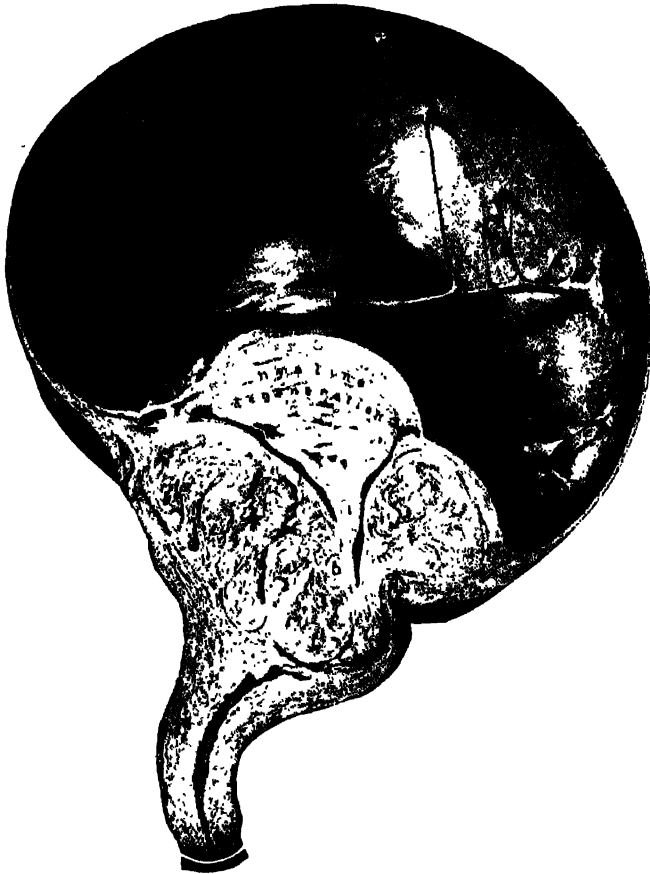
Fig. 728.—A large cystic myoma. (Kelly—*Operative Gynecology.*)
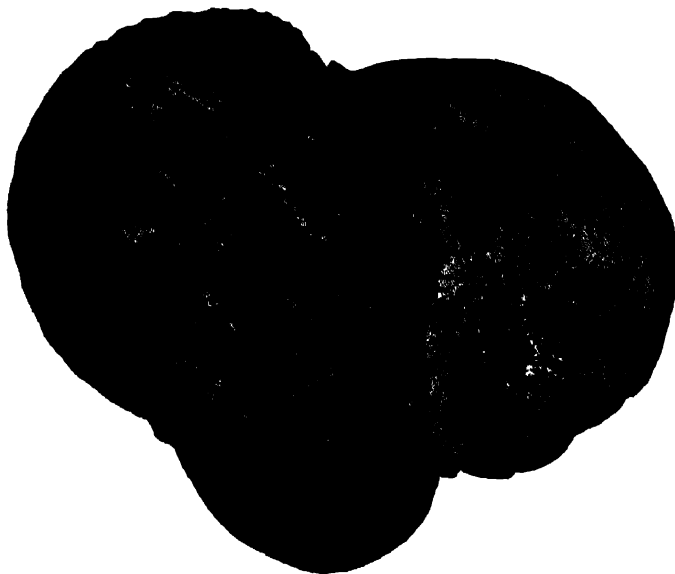
Fig. 729.—Necrosis of an intraligamentary myoma. (Hirst—*Diseases of Women.*)

myoma makes the diagnosis clear, but if the cystic part be large, as occasionally happens, it may lead to a mistaken diagnosis of ovarian cyst.

In the early stage of this necrobiotic process, before the conversion into homogeneous translucent material, the affected area has a white appearance. This feature is shown microscopically in Figs. 722 and 723. Ordinarily an area

Fig. 730.—Section of a necrotic myoma. The senior author saw the patient in consultation with Dr. C. O. C. Max. There was a large myoma extending nearly to the umbilicus, which had become necrotic from infection due to the introduction of a uterine sound by a midwife for abortion of a supposed pregnancy. The patient was in a desperate condition. At the operation it was found that the necrotic myoma had perforated the uterine wall and was in contact with the omentum. This anteroposterior section of the removed uterus and tumor shows accurately the relation of the necrotic mass to the uterine wall. It was almost free in its suppurating bed. The perforation into the peritoneal cavity was at another part of the mass. Gyn. Lab.

progresses to definite hyaline material and on to liquefaction while new white areas are forming. Occasionally the early stage of the process affects a very large area at once, a beautiful specimen of which is shown in Fig. 724.

Another interesting secondary change is *red degeneration*. Though this is usually associated with pregnancy, circulatory disturbance about the tumor may cause it in the nonpregnant, as in the specimens shown in Figs. 725 and 726. The red color is due to marked hemolysis occurring in the tumor. Microscopically numerous fragments of blood cells are seen and, as to tissue cells, the central portion of the degenerated area shows cell outlines with no nuclei
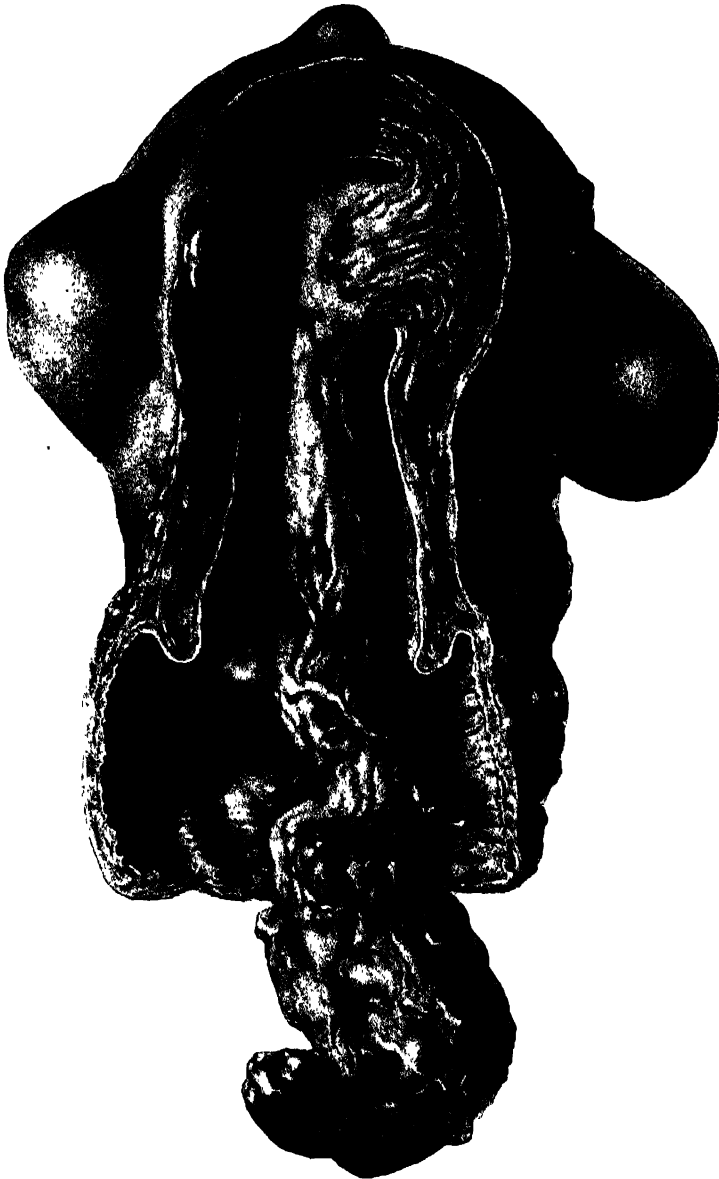
Fig. 731.—A large pediculated submucous myoma which suppurated and the greater part of which became necrotic, only the shell remaining. This collapsed shell is seen lying in the vagina. Gyn. Lab.

(the so-called "ghost cells"), while toward the periphery the usual muscle cells appear. Myomas with *cystic formation* from noninfective necrobiosis are shown in Figs. 727 and 728.

In *infective necrosis,* the infection may reach the myoma from within the genital canal or from adjacent structure or by way of the blood stream. The ensuing inflammation causes swelling of the growth within its capsule, which in turn interferes with its circulation and leads to necrosis, which may involve a part of the tumor or all of it. A small area of suppurative necrosis is shown

Fig. 732.—A sarcoma developing in the cervical stump, after a supravaginal hysterectomy for a supposedly simple myoma. After the development of the sarcoma the original tumor was sectioned and examined and several areas of sarcomatous degeneration were found in it. (Cullen—*J. A. M. A.*)

in Fig. 729. A striking example of massive necrosis, the result of a midwife's abortion attempt, is shown in Fig. 730. Submucous pediculated myomas are particularly liable to infective necrosis. In some cases this effects a cure, the suppurating disintegrating tumor being expelled, with subsequent gradual cessation of symptoms. In other cases the suppuration of the growth may lead to a serious condition with resulting general sepsis. In Fig. 731 is shown the collapsed shell of a very large submucous myoma which suppurated and became necrotic.

Sarcomatous change may take place in the interior of a myoma, which fact must be considered in deciding on and in executing the operative work. On account of this possibility all tumors removed, particularly the larger ones, should be opened for inspection as to gross structure (to decide whether or not cervical stump and adnexa also should be removed) and later submitted to microscopic investigation, so that if any sarcomatous change is present appropriate additional treatment may be carried out promptly. Fig. 732 shows a sarcoma which developed in a cervical stump a considerable period after supravaginal hysterectomy for a supposed simple myoma.

Fig. 733.—A small epithelioma of the cervix associated with myoma of the corpus uteri. In this case the most evident lesion was the myoma, but further examination revealed induration and irregularity about the external os, with some bleeding on examination. A piece of tissue excised from the suspicious area and submitted to microscopic examination showed epithelioma.

Calcification is not uncommon, and ossification may occur. They are easily recognized as stony or bony hard areas on cutting through the tumor. Fatty degeneration may occur, giving some areas of the cut surface of the myoma a yellow color and soft consistency.

5. **Complications and Associated Diseases.**—These are very numerous and very important, for a large proportion of the suffering and fatality in myoma cases comes from them. Some of these conditions are due directly to the myoma, some are due indirectly to it, and some have no etiologic connection with the

myoma, but are only associated affections. Some of them cannot be assigned
exclusively to one group or the other; therefore, all of them will be considered
together. For convenience they are divided into three classes according to local-
ity—(a) in the uterus, (b) in adjacent structures, and (c) in distant organs.

a. In the uterus is found thickening of the endometrium, distortion of the
uterine cavity, with atrophy of the endometrium at pressure points, and dis-

Fig. 734.—Large mass in pelvis formed by uterine myomas and carcinoma. (Cullen—*Cancer of the Uterus.*)

placements of the uterus from tumor growths. There may be marked distortion
of the whole uterus. Carcinoma is an important associated disease that must
be kept in mind and searched for. It may be present in the cervix (Fig. 733)
or in the corpus uteri (Fig. 734). Pregnancy also is a rather frequent compli-
cation of myoma, either as an early pregnancy with a large tumor or as a more
advanced pregnancy associated with a small tumor (Figs. 735, 736).

b. Under changes in adjacent structures come salpingitis, hydrosalpinx, and pyosalpinx. Also, compression and inflammation of the ovaries. There may be troublesome pressure on the bladder or ureters or pelvic vessels or rectum.

Adhesions to various important organs in the pelvis and lower abdomen constitute an important form of complication frequently found in myoma cases.

c. The changes in distant organs concern principally the heart and the kidneys. These changes are often serious. The frequent association of heart disturbance with advanced uterine fibroid has attracted much attention. The proportion of cases showing heart disturbance is striking.
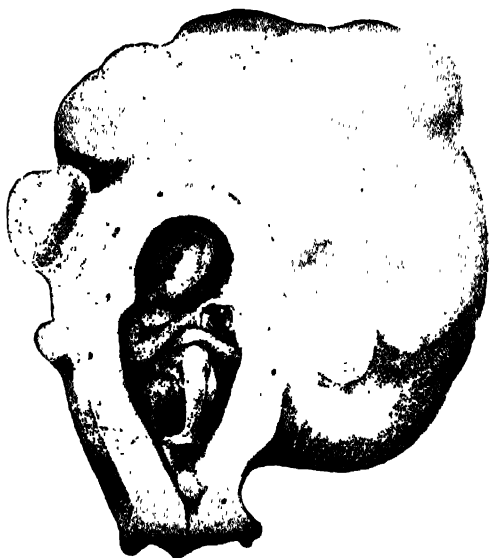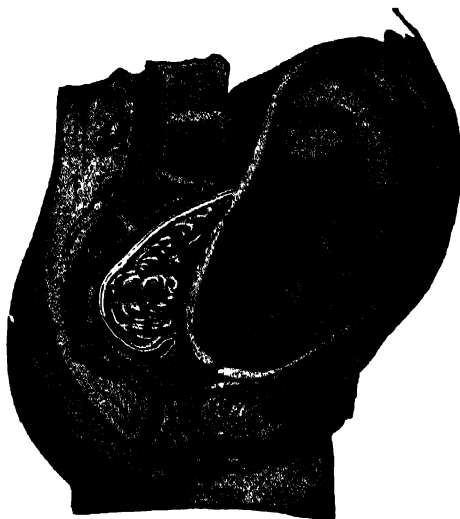
Fig. 735.   Fig. 736.

Fig. 735.—Myoma and pregnancy, the tumor forming the most of the mass. (Dudley—*Practice of Gynecology*.)

Fig. 736.—Myoma and pregnancy, the pregnancy forming the larger part of the mass. (Norris, after Simpson—*American Textbook of Obstetrics*.)

Winter had 266 consecutive cases examined for heart diseases and found heart disturbance in 40 per cent. In five series carefully examined (Winter 266, Strassmann and Lehmann 71, Boldt 79, Fleck 325, Webster 210), the number showing heart disturbance varied from 25 to 47 per cent, averaging 38 per cent for the whole 951 cases. Of course, a certain number of these heart disturbances would have been found in any series of patients. But making due allowance for these the number is too marked and constant to be a mere coincidence. The exact connection between the two has not been worked out. But whether the heart disturbances are due principally to the chronic anemia from hemorrhage or to the direct action of some toxin produced in the myoma, or constitute simply an associated product of the same conditions that produced the myoma—whatever the cause—the fact remains that they are there and must be reckoned with.

Some of these are minor functional disturbances but, on the other hand, many are of serious import. That such is the case is shown by Baldy from the records of the Gynecian Hospital. In the series of 3,413 operations, sudden postoperative death due to circulatory disturbance occurred 16 times. Thirteen of these sudden deaths occurred in the 366 fibromyoma cases, while the 3,047 other operative cases furnished only 3 such deaths. It occurred 36 times as frequently in the fibroid cases as in the general run of operative cases.

Other visceral degenerations from the chronic anemia, from pressure on the ureters and from other effects of the myoma, produce fatalities due really to the myoma but attributed to other causes.

Symptoms and Diagnosis

The **symptoms** given by the patient are, in the usual order of their appearance, (1) menorrhagia, (2) leucorrhea, (3) pressure symptoms, (4) pain and, (5) a lump in the lower abdomen.

1. *Menorrhagia.*—This is usually the first disturbance noticed, particularly in submucous and interstitial growths. There is much variation in the menstrual disturbance. Usually the flow is increased, but sometimes it is diminished. Emmet, in a series of 216 cases, found the menstrual flow decidedly increased in 50 per cent, unchanged in 20 per cent, lessened in 16 per cent, and irregular in 13 per cent.

2. *Leucorrhea* is usually present after a time, especially in the submucous and interstitial growths.

3. *Pressure Symptoms.*—These are indefinite, simply an indication that there is some slight disturbing element in the pelvis. The patient has some bladder irritability and a feeling of weight in the pelvis. There is usually constipation. After the tumor becomes large, marked pressure symptoms occur.

4. *Pain* appears later. It is usually present as a backache (lumbar or sacral) or as pain in the lower abdomen or a thigh pain on one or both sides. The pains usually come and go at first, and are worse when the patient is on her feet and also at the menstrual periods.

5. *Lump.*—In a large proportion of the cases, after some months or years a lump is noticed in the lower abdomen. If the mass is smooth, however, it is surprising how large it will sometimes get before the patient notices it. Of course a mass with nodular projections is usually noticed as soon as it begins to distend the lower abdomen. In a certain proportion of cases, the mass, even when large, is still too deeply placed in the pelvis to be appreciable to the patient, and in some cases (small submucous myoma) the mass is not appreciable to the physician, even on careful bimanual examination, though there may be much bleeding and distress.

The **diagnosis** of uterine myoma must rest on the examination findings, for the symptoms are not distinctive. Taking up the points as given in the chapter on Examination, we find as follows in the case of a fibromyoma:

1. *Position of Mass.*—In the central part of the pelvis and extending from there toward one side.

2. *Size of Mass.*—May be any size, from one barely palpable in the wall of the uterus to a large tumor filling the abdomen.

3. *Shape.*—Individual tumors are apparently spherical, but as they project from the uterus or grow beside each other, they form a mass of very irregular contour, usually presenting several distinct bosses or rounded projections outside the general outline of the mass.

4. *Consistency.*—Firm, usually much harder than the adjacent uterine wall. Occasionally part of a tumor will undergo cystic change—but even then the greater part of the mass is usually solid.

5. *Tenderness.*—Not tender, unless incarcerated in pelvis or pressing on nerves or accompanied with inflammation.

6. *Mobility.*—The tumor and uterus are movable together up and down in the pelvis, but they are not movable separately unless the fibroid is pediculated.

7. *Attachment.*—Attached in the uterine region and free elsewhere, unless complicated. But there may be conditions which fix the whole mass, due to the tumor itself or to inflammatory or other complications. A subperitoneal myoma with a long pedicle may be mistaken for a growth from some of the abdominal organs. The pedicle connecting the mass with the uterus can usually be felt on deep bimanual palpation. In a difficult case, a useful expedient is to have an assistant grasp the tumor and draw it up into the abdomen while the examiner makes deep bimanual palpation in search of the pedicle, which is thus made tense and is more easily felt. Occasionally a myoma becomes detached from the uterus or has such a long pedicle that it appears free, but that is rare.

Fig. 737.

Fig. 738.

Fig. 737.—Early pregnancy with marked retrodisplacement of uterus. (Edgar—*Practice of Obstetrics.*)

Fig. 738.—Early pregnancy with moderate retrodisplacement of uterus. (Edgar—*Practice of Obstetrics.*)

When making the diagnosis of myoma of the uterus, the following conditions and questions must be considered:

A. PREGNANCY must always be considered in any enlargement of the uterus, and the normal and abnormal conditions of pregnancy must be kept in mind. An enlarged retrodisplaced pregnant uterus which is still fairly firm because the pregnancy is early (Figs. 737, 738) may be mistaken for a myoma. This particular condition is responsible for most of those embarrassing situations in which, with the abdomen open, the surgeon finds that his "fibroid" is a pregnancy.

Farther along in pregnancy, the marked irregularity of the enlarging uterus occasionally found, as shown in Fig. 739, may lead to a mistaken diagnosis of large myoma with cystic change. On the other hand, a large myoma occasionally simulates the shape of the pregnant uterus, as in Fig. 740, and

if there is cystic change there may be simulation also of the cystic and solid areas of the pregnant uterus and contained fetus. An interesting article could be written on the prenatal care and obstetric waiting hours expended on large myomas. The senior author recalls particularly one such case in which he was called in consultation the second day of "labor."

B. OTHER DISEASES PRESENTING A MASS OR INDURATION, which may be mistaken for a myoma. The more common of these diseases are salpingitis with exudate, pelvic cellulitis, hydrosalpinx, pregnancy, extrauterine pregnancy, pelvic tuberculosis, ovarian or parovarian tumor, cancer of the uterus.
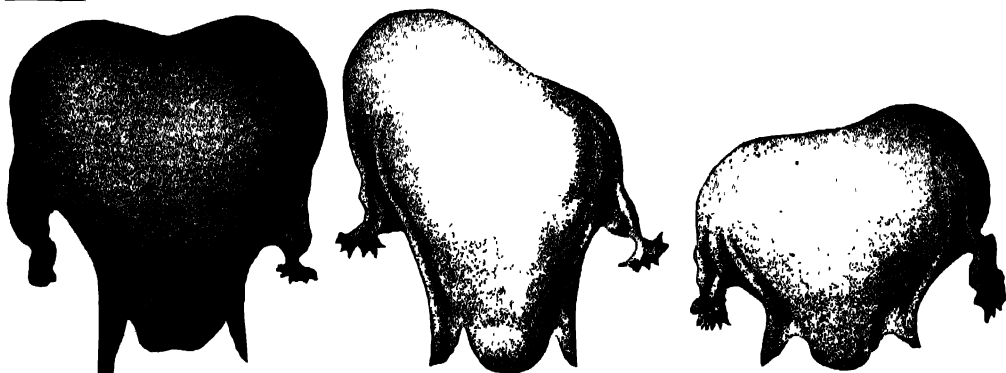
Fig. 739.—Irregular shapes that pregnant uteri may present, and which may lead to mistakes in diagnosis. (Edgar—*Practice of Obstetrics.*)
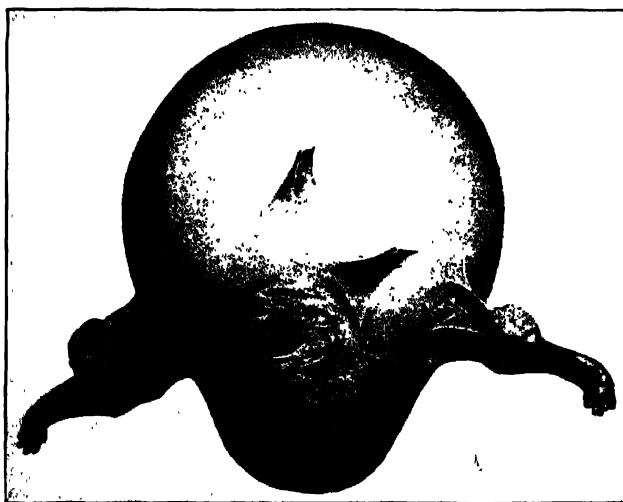
Fig. 740.—Uterus symmetrically enlarged from myomas. This might be mistaken for a pregnant uterus, on account of the close resemblance in shape. (Kelly—*Operative Gynecology.*)

C. DISEASES OF THE UTERUS WITHOUT A MASS OR INDURATION, which may be mistaken for myoma, principally on account of bleeding. For example, retrodisplaced uterus with chronic endometritis, chronic endometritis with subinvolution, carcinoma of corpus uteri, tuberculosis of uterus, prolapse of uterus, inversion of uterus (Figs. 741 to 749).

D. MYOMA WITH COMPLICATIONS. In a case presenting anomalous symptoms, the condition may be a myoma complicated with pregnancy or extra-

Fig. 741.

Fig 742.
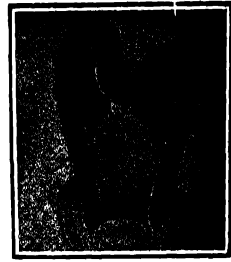
Fig. 743.

Fig. 741.—Beginning inversion of the uterus.
Fig. 742.—Submucous myoma with short pedicle.
Fig. 743 —Submucous myoma and beginning inversion.
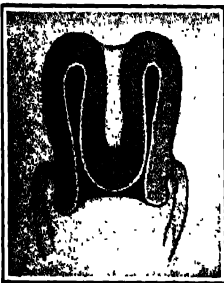
Fig. 744
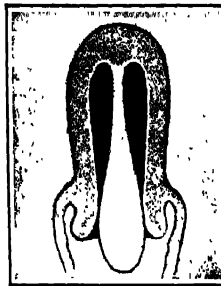
Fig. 745

Fig. 746.

Fig. 744.—Partial inversion of uterus.
Fig. 745.—Submucous myoma with long pedicle.
Fig. 746.—Pediculated myoma and partial inversion.
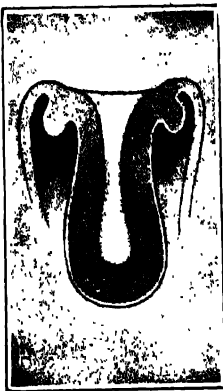
Fig. 747.

Fig. 748.
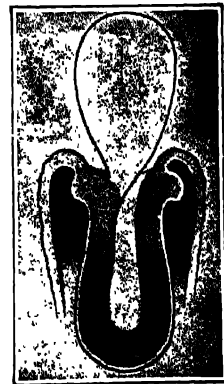
Fig. 749.

Fig. 747.—Complete inversion of uterus.
Fig. 748.—Pediculated myoma filling upper part of vagina.
Fig. 749.—Complete inversion of uterus, with a pediculated subperitoneal myoma occupying the normal site of the uterus.

Figs. 741 to 749.—Diagnosis—inversion and pediculated myoma. (Dudley—*Practice of Gynecology*, Lea and Febiger.)

uterine pregnancy or salpingitis or ovarian tumor or broad ligament tumor
or malignant disease of the uterus or retrodisplacement or ascites. When a
cul-de-sac mass is present, consider the possibilities shown in Figs. 750 and 751.

E. ADDITIONAL QUESTIONS. After it has been established that a uterine
myoma is present, the following points are to be considered:

1. Does the myoma cause all the symptoms? If not, what symptoms are
   caused by it? What causes the other symptoms?
2. What is the relation of the tumor or tumors to the uterine wall and
   cavity?
3. What is the relation of the tumor or tumors to the other pelvic organs
   and to the pelvic wall and to the peritoneum?
4. What complications are present —particularly pregnancy, malignant dis-
   ease, pelvic inflammation, heart disease, kidney disease?
5. What has been the progress of the disease in this case, and what\will
   probably be the further progress?
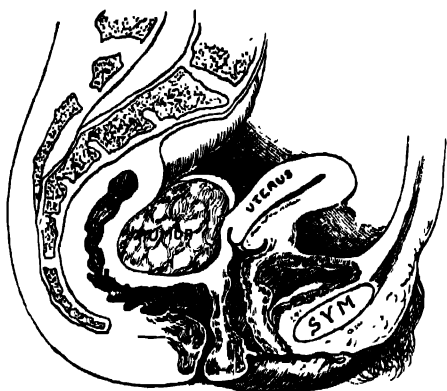
Fig. 750.   Fig. 751.

Fig. 750 —A myoma forming a mass behind the uterus. (Montgomery—*Practical Gyne-cology*.)

Fig. 751.—A retroflexed uterus and a myoma forming a mass behind the cervix. (Mont-gomery—*Practical Gynecology*.)

In cases where it becomes important to know definitely whether or not
the tumor is submucous and the extent of its encroachment on the endometrial
cavity, the cavity may be outlined by x-ray with injection of opaque material.
The distortion of the cavity is shown, and the size and location of the myoma
are indicated by its filling-defect. There is a certain amount of danger con-
nected with injecting material through the genital tract into the peritoneal
cavity, particularly just preceding abdominal operation. Though the danger
is slight and these valuable methods of obtaining required information are
carried out regularly in suitable cases, the fact of some risk must be kept in
mind, and such preoperative peritoneal invasion should be carried out only
when the need for the additional information justifies it. This opaque injec-
tion is principally useful in outlining the uterine cavity in cases involving
decision for or against myomectomy, in the hope of preserving sufficient uterus
for subsequent childbearing.

Treatment

In regard to treatment there are three propositions to be considered: (A) no treatment, (B) palliative treatment, and (C) curative treatment.

A. No Treatment

A certain small percentage of myomas are discovered by accident, i.e., during a pelvic examination for symptoms not due to the fibroid. The myoma is small, has caused no symptoms, is not likely to cause symptoms soon, and is not likely to aggravate the symptoms due to the other trouble.

Such a tumor requires no treatment, and it is just as well, as a rule, that the patient be not informed of its presence. She should, however, be kept under observation, to see whether there is any increase in the growth. Explain the condition to the husband or other responsible relative, that your skill be not called in question should the patient be examined by some other physician and the presence of a tumor announced.

There is one class of small myomas that the authors feel constitutes an exception to this rule. When situated in the lower part of the uterus, a myoma of any considerable size is a dangerous matter in the childbearing period. If pregnancy should take place, the tumor will probably increase in size and may become a serious menace to labor at term. Again, a cervical myoma is likely to cause symptoms (bladder, rectal, or menstrual) at any time, even though small. Such a tumor in a married woman should be removed. If not complicated by tumors elsewhere in the uterus, it may be approached from the vagina and removed by a comparatively simple operation.

B. Palliative Treatment

Palliative treatment is symptomatic. It is directed toward relieving the disturbances occasioned by the fibroid and making the patient more comfortable. The principal disturbances requiring the palliative treatment are the bleeding and the pressure symptoms.

The palliative measures are (1) tonic measures, (2) uterine astringents and endocrines, (3) vaginal treatment, and (4) curettage.

1. **General Tonic and Hygienic Measures.**—The better the patient's general health, the less the annoyance from the myoma. Consequently, there should be employed laxatives (as in pelvic inflammation), tonic medicines, avoidance of long walks, rest at the menstrual periods, douches as indicated by discharge, and a general regime to improve the general health and diminish pelvic congestion.

2. **Hemostatic Remedies.**—These are employed when needed on account of extra menstrual flow or intermenstrual bleeding. The use of the various hemostatic remedies to control uterine bleeding is considered in detail under menorrhagia and metrorrhagia in Chapter XIV.

3. **Vaginal Treatment.**—Antiseptic vaginal douches are required in cases presenting leucorrhea or bloody discharge. Vaginal packing may be needed to check bleeding temporarily or to raise an impacted tumor out of the pelvis.

4. **Curettage.**—Curettage may control bleeding temporarily in those cases in which the bleeding is due to hyperplasia of the endometrium. In many cases, however, the cavity is so distorted that the curette can only wound

parts of the wall here and there without removing the entire endometrium. In addition to this uncertainty of controlling the hemorrhage, there is danger of infection of the uterine wall or infection and necrosis of the growth, leading to an exceedingly dangerous condition. Schroeder reports a case of necrosis of a submucous tumor, the capsule of which had been torn by the curette.

In carefully selected cases, curettage may be advisable, partially as a diagnostic measure, but there must be a clear understanding of the dangers incident to it and good reason for taking the risk. In the hands of those experienced in the selection of cases and in the use of the curette, the probability of any serious complication from a clean curettage is not great. But there is great risk in careless intrauterine instrumentation in these cases, even the simple introduction of the uterine sound (see Fig. 730).

C. Curative Treatment

In the curative treatment of myomas, three measures are employed—**radium, x-ray,** and **operative removal.** These are not antagonistic or exclusive one of the other. Rather they are supplementary. Each has its field in which it is clearly the best treatment. The edges of the fields merge, of course, giving classes of cases in which the choice is not strongly one way or the other.

Radium.—Radium is the preferable form of treatment in the following classes of cases:

1. In uncomplicated small and medium-sized myomas in patients in the menopause or near the end of the childbearing period. Persistent bleeding is usually the serious symptom in these cases, and this is promptly controlled by radium, which checks all bleeding, menstrual or otherwise. Nearly all properly selected cases prove amenable to this treatment. In approximately 400 reported cases, satisfactory results were secured in about 95 per cent.

In the cases of myoma apparently suitable for radium treatment, complicating carcinoma of the endometrium must be excluded by curettage. This is very important as illustrated by the following two cases close together. Each case presented myoma nodules of the size and type suitable for radium treatment. Following the usual custom at radium application, a curettage was made and the tissue sent for routine examination. The laboratory showed complicating endometrial carcinoma, and this diagnosis was confirmed in each case by the findings in the removed uterus. In one case the associated carcinoma was rather extensive and in the other case it was still confined to a small area.

Painful conditions in the pelvis are not likely to be relieved by radiation. Consequently when the myoma is causing pressure pains, on account of size or location, or when there are inflammatory or other conditions making pain a prominent symptom, operation is preferable.

In young women the importance of preserving ovarian function is a contraindication to radium or x-ray. In such cases, operative removal of the myoma is the preferable form of radical treatment. Myomectomy is performed if conditions are favorable, in order to preserve the childbearing function, and in unfavorable conditions the uterus is removed along with the tumors, with preservation of ovaries.

2. In patients with kidney, heart, and other complications giving undue operative risk, radium may reasonably be tried in the somewhat larger growths.

In these complicated cases, also, carcinoma of the endometrium should be excluded by curettage, if possible. Of course, in these seriously complicated cases, general anesthesia is to be avoided. In the authors' experience the curettage and radium application may in most of these cases be accomplished under morphia-hyoscine analgesia. In the exceptional cases where necessary this analgesia may be supplemented by local infiltration anesthesia of the cervix.

In the handling of radium cases we have developed a special method of suturing the radium in place, so as to facilitate easy removal. The details are as follows:

Special suture facilitating removal. After introduction, the radium is fastened securely in place by a suture passing first through one side of the cervix, then through the rubber tubing, and finally through the other side of the cervix, as shown in Figs. 752 and 753. The suture is not tied at this time. The ends are left long, and later are tied over the vaginal packing. A moderate vaginal packing is then placed, the bulk of it being back

Fig. 752. Fig. 753. Fig. 754.

Fig. 752.—Radium implantation for myoma. Fastening the radium package securely in the uterus by a method which permits easy removal with very little disturbance to the patient. Passing the suture through the cervix and the rubber tubing.

Fig. 753.—Suture passed, and ends left long and brought outside. The end of the gauze packing is tied to the radium string.

Fig. 754.—The packing in place and the suture tied over the packing. This is the only knot in the suture. This arrangement holds the packing in place and also permits easy removal later. (Crossen and Crossen—*Operative Gynecology.*)

of the cervix to push away the rectum and posterior vaginal vault (Fig. 754). It is not necessary in these myoma cases to push the bladder and rectum far away by an extremely tight packing requiring a retained catheter, as must be done in carcinoma of the cervix on account of the large dosage necessary and the location of the radium.

It is well to use vaseline-gauze for this packing, so as to avoid the vaginal irritation resulting from ordinary gauze pressed against the vaginal wall for a considerable period. After the packing is in place, the ends of the holding suture are tied over, as shown in Fig. 755. This method of arranging the suture is to facilitate easy removal of the radium without much disturbance of the patient.

Removal of radium. One hour before the time for the radium removal the patient is given a hypodermic of ¼ gr. of morphine and one ampoule of hyoscine. At the time of removal the patient's hips are brought to the edge of the bed, the end of the suture is caught with a forceps, and the suture-loop over the gauze is brought into view (with or without a speculum as needed) and cut with scissors (Fig. 755). Then a pull with the

forceps holding the suture end will pull out the whole suture, as there is no knot in it. This releases the packing and the radium, which are then removed (Figs. 756 and 757).

Aftercare. On account of the circulatory and other disturbance from the curettage and radium treatment, often combined with conization, the patient is kept in bed a couple of days. If there is no special local disturbance, she is then allowed up, and the activity is gradually increased so that she is ready to go home in from three to six days after the radium is removed. Getting the patient home quickly is not the main object, but giving the radium treatment safely and with minimum deleterious effect. Undue early activity, adding congestion to that already present from the radium treatment, may cause local disturbance that would not otherwise occur.

X-Ray. The very large growths in patients presenting undue operative risk are best handled by deep x-ray therapy. In most cases this will, after a time, stop the bleeding temporarily and give a chance to build up the patient for operation. If she cannot be gotten into condition for operation, continua-

Fig. 755.   Fig. 756.   Fig. 757.

Fig. 755.—Removal of the radium. Cutting the suture over the gauze packing near the vaginal entrance. This releases the suture, so that it may be pulled out, and also releases the packing and the radium, as explained in the text.

Fig. 756.—Removing the packing. As the end of the packing comes out, it brings out the radium string which is tied to it.

Fig. 757.—The radium string brought out. Then a firm steady pull on the string brings out the radium package. (Crossen and Crossen—*Operative Gynecology.*)

tion of the x-ray treatment may stop the bleeding permanently and diminish pressure symptoms by shrinking the growth.

If preferred, the smaller growths also may be treated by x-ray instead of radium, if the patient has had a recent curettage excluding malignancy.

Operation.—Operative removal of the myoma is the preferable form of treatment in three classes of cases, as follows:

1. The large growths, from the size of a grapefruit and upward, are generally best handled by operation. It is not practicable to fix an arbitrary limit of size, as other conditions have a bearing on the decision. For example, pediculated subperitoneal growths are not so favorable for radium or x-ray treatment as growths embedded in the uterine wall and hence must more often be removed by operation. Again, a single large growth is not so favorable for nonoperative treatment as a myomatous uterus enlarged to the same size by a number of small nodules.

2. In young women in whom preservation of the childbearing function and of menstruation is desirable, myomectomy is the preferable form of treatment, where any serious

treatment at all is necessary. In many of these cases the myomas may be removed without disturbing the functions of the uterus. A point to be kept in mind, however, is that when the abdomen is opened it *may* be found necessary to sacrifice the uterus in order to remove the tumors completely. Hence myomectomy should be advised only after careful consideration of all the features of the case. If the growths are not of a size and location necessarily interfering with pregnancy or labor, it would be well to try first to check the bleeding by other means, such as curettage and internal medication. If these measures fail, it may be advisable in exceptional cases to employ light doses of radium or x-ray, with the idea of giving just enough to control abnormal bleeding but not enough to affect ovarian or uterine function seriously. But in spite of advances made in the regulation of dosage and the enthusiastic assumptions of some authorities, this use of these measures must be with very decided caution. If the x-ray is used, it is preferable to apply it to one side only, so that one ovary will remain unaffected.
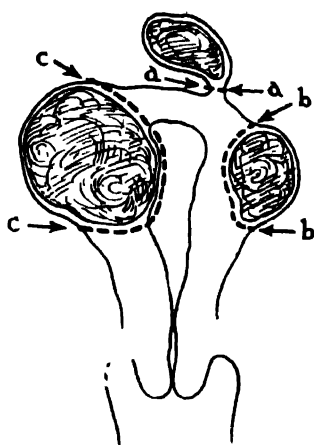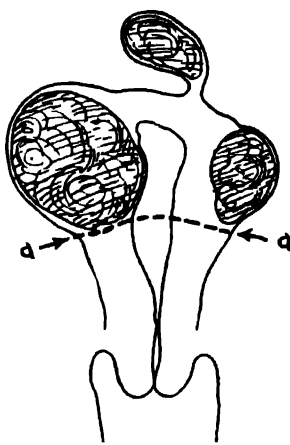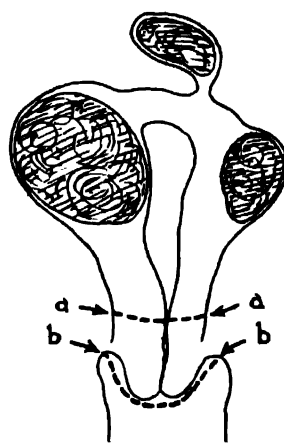
Fig. 758.   Fig. 759.   Fig. 760.

Figs. 758 to 760.—The principles involved in the different types of abdominal operation for uterine myoma.

Fig. 758.—Myomectomy—for a pediculated subperitoneal myoma, for a sessile subperitoneal myoma, and for a myoma that extends to endometrium. Fig. 759. Partial hysterectomy—preserving a considerable part of the corpus uteri and endometrium in the hope of preserving menstruation. Fig. 760. Hysterectomy—supravaginal hysterectomy and complete hysterectomy.

3. In complicated cases the complications often make operation advisable in a growth which if uncomplicated would be suitable for radium or x-ray treatment. The complication may be inflammation of some adjacent structure, for example, appendicitis or salpingitis. Such associated trouble is found in a considerable proportion of the cases of myoma. The complication may be inflammation or degeneration of the myoma itself. Degeneration is common in the larger growths, especially in the subperitoneal masses. A myoma that takes on growth after the menopause is probably undergoing a degenerative change of some kind and should be promptly removed if the patient is a safe operative risk.

The various operative measures looking to the removal of the growth are as follows (Figs. 758 to 760):

Myomectomy.—Removal of the tumor or tumors and preservation of the uterus.

ABDOMINAL MYOMECTOMY.—Enucleation from the outer surface of the uterus.

VAGINAL MYOMECTOMY.—Enucleation from the cervix or from within the uterus by splitting the cervix.

Total Hysterectomy.—Removal of the tumor and of the entire uterus, including the cervix. This is carried out through the abdomen or through the vagina, as thought best in the particular case.

Supravaginal Hysterectomy.—Removal of the tumor and of the body of the uterus, leaving the cervix. This is, of course, carried out through the abdomen and is ordinarily employed only when the cervix is in good condition. If, on account of poor operative risk or special intrapelvic conditions encountered, it is employed when there is chronic cervicitis, the cervicitis area should be removed by conization from below at the close of the abdominal work or later, on account of the danger of cancer development.

PREGANCY AND MYOMA

The association of myoma with pregnancy is always a matter for serious concern, though many patients get along without trouble.

The treatment to be employed depends on the size and location of the myoma and the stage of pregnancy at which the patient is seen.

When the tumor is in the upper part of the uterus and is of small or medium size and not causing much trouble, it should be let alone until after parturition.

When the tumor is so large or so situated (cervix myoma) that it precludes the possibility or probability of full-term delivery per via naturalis, the treatment turns somewhat on the stage of pregnancy. If the patient is seen in early pregnancy, hysterectomy is the safest plan of treatment. In some exceptional cases the tumor may be so situated that myomectomy (abdominal or vaginal), with hope of continuing the pregnancy, is justifiable.

Reis and Sinykin report a series of eighteen myomectomies during pregnancy with sixteen of the patients going to term. They give the following conclusions:

"1. The indications for myomectomy are acute degenerative changes, hemorrhage, infection, twisted pedicle, or rapid growth together with encroachment upon the birth canal.

"2. The recommended technique must include (1) minimal handling of the pregnant uterus; (2) the myomectomy with the uterus in situ if possible; (3) complete avoidance of the uterine cavity; (4) careful hemostasis and peritonization; (5) removal of only the guilty fibroid.

"3. Myomectomy during pregnancy is a comparatively safe procedure for both the mother and the fetus and should be performed promptly whenever indicated."

If the patient is seen, for the first time, in late pregnancy, it may be advisable to postpone operation until full term or nearly full term, with the hope of saving the child by cesarean section.

Of course, there are all gradations in seriousness, from the cases in which it is almost certain that there will be no trouble to the cases in which full-term delivery by the natural route would be absolutely impossible. It is the middle class that contains the cases which furnish the most puzzling problems. When seen in early pregnancy there is an uncertain factor, namely, the probable extent of development of the myoma during pregnancy. This makes it difficult in some cases to decide just which line of treatment is preferable. In cases of doubt, after giving due consideration to the various aspects of the case, the rule is to await developments.

A numerous class of myoma cases complicated by pregnancy is that in which the patient has one or more myomas that give no particular trouble until she becomes pregnant. After the patient has been pregnant three or four months the symptoms become so acute and threatening that operation is required.

MISCELLANEOUS GROWTHS

Nonmalignant tumors of the uterus other than myoma are rare. Ritter and Stringer report a case of **lipoma** and review the subject. The following quotation is from their article.

The histogenesis of fatty tumors of the uterus has not, as yet, received definite interpretation. Von Franque views it as an example of metaplasia. Merkel believes they arise from displaced embryonic mesoderm. Knox considers them as supporting Conheim's theory of embryonic rests, which in developing, produce fatty tumors. Brunings' belief coincides with that of Lockyer who expounds the premise that lipomas of the uterus are the result of the transformation of muscle bundles into fat. In addition, the Wolffian duct theory of Wilms and the growth of true fat along nerve and blood vessels from adjacent structures have been brought forward as possibilities of pathogenesis.

Elkin and Hawthorn have reviewed carefully the various theories of histogenesis and conclude that the question involved is whether the tumor is composed of true fat cells arising from a lipoblast or whether some other type of cell such as connective tissue cells has undergone fatty infiltration. They favor the lipoblastic origin of these tumors. Meyer and Sydel believe they arise from displaced embryonic mesoderm. Starry feels that they must represent either the type of connective tissue cells commonly found in the uterus or that they represent some specially differentiated type of lipogenic connective tissue cell. In reviewing these theories, it is noted that they form two groups, the question being whether lipomas of the uterus arise from a true fat cell, the lipoblast, or whether or not a metaplasia of a different type of cell occurs, it being infiltrated with fat globules and transformed into fat-bearing cells.

This instance of a fatty tumor of the uterus reveals a mass of fat-containing cells supported by connective tissue stroma and surrounded by a thin capsule of connective tissue and condensed uterine muscle. Nowhere in multiple sections of the primary tumor mass have there been discovered muscle, cartilage, or other tissue elements. All the cells are mature fat-containing units and nowhere can there be noted evidence of metaplasia or fatty degeneration. In direct contrast, the adjacent typical leiomyoma contains no fat-bearing cells or fatty change of any kind. The evidence presented is directed in favor of a true lipoma of the uterus.

Humphrey and Mustard report a case of well-defined **lipoma** of the uterus, with a carcinoma in the same organ. Weitzman, Sheer and Polayes report a **papillary cystadenoma** of the uterus, apparently arising from wolffian remnants in that organs. The following quotation is from their article:

In the opinion of the authors, this tumor is probably of wolffian body origin. Notwithstanding Cullen's view that one cannot differentiate from the histologic picture a wolffian or müllerian origin of intramural cysts, the histologic picture of this newgrowth is apparently not of endometrial or tubal origin as evidenced by (a) the failure to trace continuity to either of these structures by serial sections as well as by (b) the absence of endometrial stroma in the tumor. On the contrary, the histologic picture of the newgrowth more closely simulates that of the epoophoron (wolffian body rests). This is in conformity with the observation of Ivanov, whose work shows the part played by the wolffian body in the formation of the uterine wall. Mercadé has demonstrated that the location of these wolffian body rests may be at the cornua, in the fundus, or along the lateral wall of the uterus. The structure and location of the mass in this case therefore may be considered a papillary cystadenoma of wolffian body origin and as such should be recognized as distinct from the adenomyomas of heterologous origin.

CANCER OF THE UTERUS

Cancer of the uterus is very common, running about even with cancer of the stomach for the sinister distinction of being the most frequent form of malignant disease occurring in the body. Welch, in a series of 31,000 carcinoma cases, found that the primary growth was in the uterus in 29 per cent and in the stomach in 21 per cent. Other series show somewhat different proportions. Of cancer of the female genital tract 93 per cent were uterine, according to the statistics of Hecht. Kamperman found cancer of the uterus in 4 per cent of all gynecologic cases.

Cancer of the uterus includes malignant growths of the cervix and malignant growths of the corpus uteri. Cancer of these two parts of the uterus differs so much in structure and in the problems of diagnosis and treatment that it is advisable to consider them separately. The disease occurs as carcinoma or sarcoma.

The subject of this chapter then may be divided into three parts, as follows:

Carcinoma of the Cervix Uteri
    Squamous-Celled Carcinoma (Epithelioma).
    Cylindrical-Celled Carcinoma (Adenocarcinoma).
Carcinoma of the Corpus Uteri
    Endometrial Carcinoma.
    Chorionepithelioma.
Sarcoma of the Uterus (Cervix and Corpus)

CARCINOMA OF THE CERVIX UTERI

This term signifies malignant disease of epithelial origin, situated in the cervix. It may arise from the squamous epithelium covering the vaginal surface of the cervix, in which case it is a squamous-cell carcinoma or "epithelioma." It may arise from the glandular epithelium in the interior of the cervix, in which case it is a cylindrical-cell carcinoma and is ordinarily designated adenocarcinoma. The cervix is the most frequent site of cancer of the uterus. Frankl states that 89 per cent are located there. Cullen in a strict analysis of his 128 cases of carcinoma of the uterus found that 93 (73 per cent) were in the cervix.

Etiology

The underlying cause of carcinoma, as of other forms of new growth, is still a mystery. An enormous amount of experimental work the world over has been directed toward discovering exactly the nature of the cause. Though the primary object has not yet been attained, the work has resulted in the accumulation of a vast store of knowledge on the negative side, that is, show-

ing definitely what it is not. This is an important step toward the final solution of the problem of cause, and it is valuable also in that it enables separation of wheat and chaff in the accumulating great mass of cancer literature.

To mention only one point as an example, the available evidence indicates that cancer is not due to a specific infectious agent, of either the microscopic or ultramicroscopic (virus) type. This eliminates the probability of finding a specific vaccine or serum. In spite of this, the literature contains voluminous and circumstantial accounts of how the cancer germ was traced to its lair and given quietus by this or that vaccine or cancer serum.

In his recent interesting and instructive summary of the fundamentals of cancer therapy, as a basis of present treatment and future developments, Carl Voegtlin, Chief of the National Cancer Institute of the Public Health Service, touches on this etiological problem as follows:

> Both clinical experience and extensive study of cancer in animals strongly suggest that cancer is caused by the transformation of the normal cells of the body into cancer cells through the operation of a great diversity of factors and agents operating from within or from without the organism. As far as known now the malignant transformation is irreversible and expresses itself in a varying degree of differentiation and increased rate of cellular proliferation. What one needs to know in order to discover a rational specific therapy is (1) why the biologic behavior of cancer cells differs from the original normal cell and (2) what kind of biochemical differences account for the differences in biologic behavior. Such fundamental questions can be answered only on the basis of a much better understanding of cell physiology and biochemistry, as well as the functional and chemical interrelation of the various tissues and body fluids. There is reason to hope that this approach will be fruitful, given sufficient time.

Though the underlying cause of cervix cancer has not yet been discovered, some contributing factors have been identified, including age, chronic irritation, certain types of endocrine imbalance, and certain vitamin deficiencies. In regard to age, cancer of the cervix occurs most frequently in the decade between forty and fifty.

> Koblanck gives the following age distribution from the statistics of 6,071 cases of both types of cervical carcinoma collected from the literature: Ages ten to nineteen, 2 cases, 0.03 per cent; twenty to twenty nine, 220 cases, 3.6 per cent; thirty to thirty-nine, 1,472 cases, 24 per cent; forty to forty-nine, 2,168 cases, 33.7 per cent; fifty to fifty-nine, 1,464 cases, 24 per cent; sixty to sixty-nine, 531 cases, 8.7 per cent; seventy to seventy-nine, 214 cases, 3.5 per cent. Of 1,583 cases of cervical cancer reported by Schreiner and Wehr in 1934, 4.9 per cent were in women aged thirty or younger. The decade forty to fifty is the age of greatest frequency, but cervical cancer may occur at any age. Findley has reported a case in a six-month-old infant.

In regard to chronic irritation, *pregnancy* with associated lacerations of the cervix at delivery and subsequent chronic cervicitis plays an important rôle. The incidence of carcinoma of the cervix does not rise with multiple pregnancies according to Deelman, who states that one childbirth is as effective a cause as repeated labors. The subsequent *chronic cervicitis* is apparently the important factor in causing carcinoma to appear so frequently in this location. In the previously mentioned series in young women, reported by Schreiner and Wehr, all but one had had children and all gave a history of leucorrhea.

Bailey studied 850 infected cervices in "an inquiry into the basic cause and nature of cervical cancer," and reached the conclusion that chronic cervicitis is a definite and important factor in the causation of squamous-cell carcinoma of the cervix. He states among his findings: "Cervicitis and erosion of the cervix are definitely related to cancer of the cervix. . . . This relationship is effected through the agency of a factor common to both—an associated inflammatory exudate in contact with the epithelium. This is the intermediate causal factor, and is constant." This sums up the findings of authorities on this point, and it is hardly necessary to go into the various details worked out in the many papers on it.

The relationship of *leucoplakia* of the cervix to carcinoma was discussed to some extent under Leucoplakia, and it would be well to refer back to that in taking up this subject. In articles by Hinselmann, Hofbaur, Schmitz and Benjamin, and others a direct relationship, at least in certain cases, is clearly demonstrated. Borst states that the importance of leucoplakia in the development of carcinoma merits further clinical and pathological investigation. Schmitz cites cases showing the origin of carcinoma from leucoplakia. Hinselmann cites six cases of traced leucoplakia of the cervix that eventuated in cancer.

The work of recent years in animal experimentation indicates that *excess estrin* in combination with chronic irritation increases the tendency to abnormal cell growth and cancer. The marked physiologic stimulation of the epithelium of the genital tract by estrin might well be a factor in abnormal growth if wrongly directed by disturbing conditions. This influence is further discussed under Carcinoma of the Corpus in this chapter and also under Delayed Menopause in Chapter XVI.

Pathology

Cancer of the uterus is, in the beginning, essentially a local process. The apparently independent growths appearing later in various organs are simply metastases from the primary tumor. This fact has been firmly established by the most thorough and painstaking investigation by many authorities. The supposition that it is simply the local manifestation of some constitutional dyscrasia has no foundation. The important bearing of this on treatment is apparent.

Carcinoma of the cervix occurs in two forms: squamous-cell carcinoma (epithelioma) arising from the vaginal surface of the cervix, and the cylindrical-cell carcinoma (adenocarcinoma) arising from the glandular epithelium of the cervical canal. The squamous-cell variety is by far the most frequent. In Cullen's reported series of 93 cervix cancers, 74 (79.6 per cent) were squamous-cell and 19 adenocarcinoma. In our Barnes Hospital series of 121 cervix cancer cases analyzed, 108 (89 per cent) were squamous-cell and 13 adenocarcinoma.

SQUAMOUS-CELL CARCINOMA

The squamous-cell cancer of the cervix originates from the squamous epithelial cells covering the vaginal portion. Arising from that part of the cervix known as the "portio vaginalis," it is sometimes spoken of as "cancer of the portio."

The disease begins as a spot of infiltration on the vaginal surface of the cervix, at a point of persistent irritation. If the patient happens to be examined at this stage, the irritated spot is seen. That is all. There is no pain, there may be no bleeding or discharge, though there may be some discharge from the preceding chronic irritation. So far as the naked-eye appearance is concerned, it does not differ materially from a small area of chronic inflammatory infiltration or erosion.

The essential pathologic change is in the character of the epithelial cells at that point, and later they penetrate into the underlying connective tissue, as shown in Fig. 761. This invasion is resisted by the leucocytes which collect in the adjacent tissue.

Gross Pathology.—As the process continues, the carcinomatous infiltration, with the opposing round-celled (leucocyte and lymphocyte) infiltration, penetrates deeper into the tissues and the small area of induration gradually increases in extent. A small abrasion or ulcer appears (Fig. 762), or there may be a raised papillary area (Fig. 763). This usually bleeds slightly when

Fig. 761.—Section of a small squamous-cell carcinoma of the cervix. Section of the entire width of the cervix. At the left is seen the wall of the canal, with cervical mucosa and glands. At the upper left angle is the external os, and some distance out from the external os is the carcinoma. It is situated in an area of old erosion, remnants of the glandlike depressions being still present under the surface.
Surface inspection of this cervix would show only an area of irritation—nothing suggestive of the sinister activity going on underneath. Gyn. Lab.

touched. Frequently the first evidence of anything wrong noticed by the patient is this slight streak of blood or spot after coitus or after extra walking or other exertion. Already the disease has penetrated deeply into the cervix and out into the parametrium, as indicated in Fig. 764.

As the disease extends in the cervix, infiltration becomes appreciable on palpation and more ulceration (which may be mistaken for laceration or erosion) may be seen through the speculum. The disease is continuously progressive, the destructive cells penetrating more and more of the surrounding healthy tissues and to adjacent lymph vessels and glands, until there is a continuous mass of cancer tissue blocking the pelvis as in Fig. 765, with extensions to higher pelvic and abdominal glands (Fig. 766).

If there is much ulceration the cervix may be destroyed, its location at the vaginal vault being occupied by a granulating cavity as in Fig. 767. On the other hand, particularly in the aged with very slow-growing epitheliomas,

the formation of contracting scar tissue may so draw in the affected region that it cannot be seen. In such a case it can be appreciated only by palpation, which reveals induration at the vaginal vault (Fig. 768). All this time the growth is extending out into the parametrial tissues toward the adjacent organs and the pelvic wall.
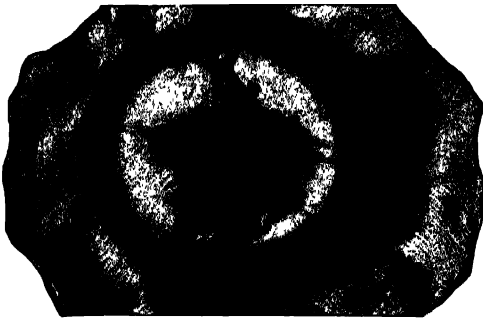
Fig. 762.
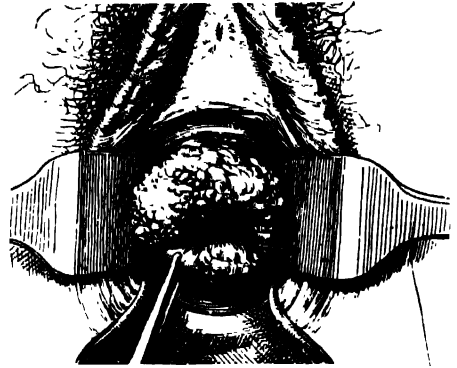
Fig 763.

Fig. 762.—Drawing from a specimen of squamous carcinoma, or epithelioma, of the cervix. Notice that it has begun at one of the angles of the stellate tear. Gyn. Lab.

Fig. 763.—Epithelioma of the cervix, appearing as a papillary growth. (Kelly—*Operative Gynecology*.)
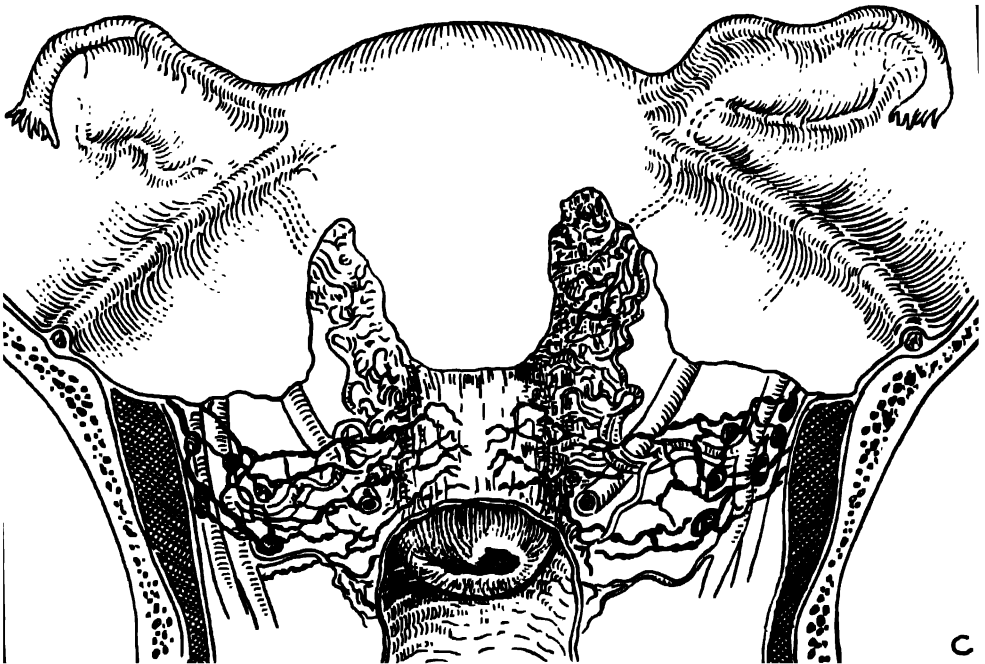
Fig. 764.—Early extension to deep-lying structures at the pelvic wall, as here indicated, *before* troublesome symptoms appear, is the cause of the high percentage of advanced cases found at first examination and the low percentage of cures.

In certain cases the carcinomatous ulceration extends into the bladder and into the rectum (Fig. 769), causing leakage of the contents of those organs into the vagina. In the later stages there may be compression of the pelvic

nerves and vessels, causing severe suffering and persistent edema of the lower extremities. Compression of the ureters with back-pressure destruction of the kidneys, as in Fig. 770, is a frequent terminal condition.

A **clinical classification** into **stages** is required for recording the extent of the disease in each case, along with the treatment measures employed and the
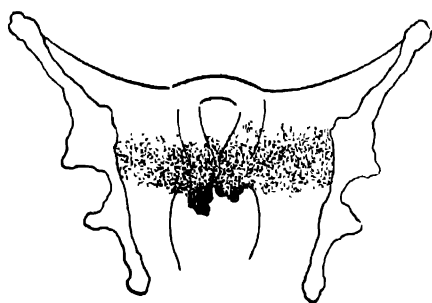
Fig. 765.
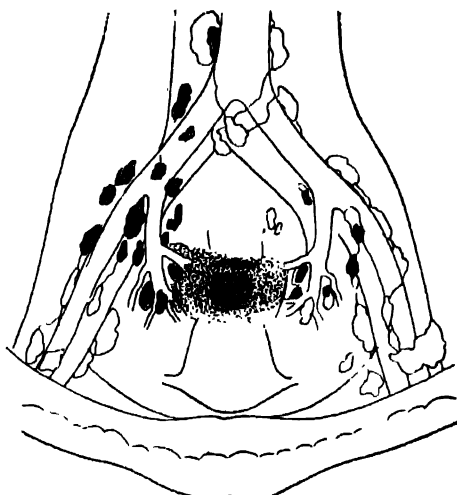
Fig. 766.

Figs. 765 and 766.—Diagrammatic representation of pelvic extension of carcinoma of cervix uteri. Fig. 765. Parametrial involvement extending out to the pelvic wall on each side. Fig. 766. Involvement of the pelvic lymph glands. The general location of the different groups of glands is indicated by the dim outlines, and the involved portions by the dark areas. The internal iliac (hypogastric) group are usually the first involved

Fig. 767.
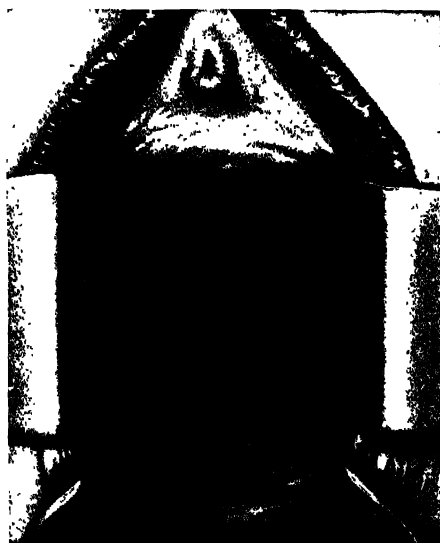
Fig. 768.

Fig. 767.—Epithelioma of the cervix. The cervix has been destroyed, leaving only an area of cancerous ulceration at the top of the vagina. (Kelly—*Operative Gynecology.*)

*Fig. 768.—Epithelioma of the cervix. The cervix has been destroyed and the affected area has been drawn in by the gradual contraction of the infiltrated tissues, until no cancerous tissue can be seen. Palpation, however, shows that there is infiltration of the area enclosed within the dotted line. (Kelly—*Operative Gynecology.*)

results attained. The same classification should be used by all workers. A uniform classification in stages representing the extent of involvement is imperative for comparison of results of various methods of treatment. The classification of the Cancer Committee of the League of Nations is satisfactory; it is already in rather general use and is the only classification likely to come into universal use. It groups the cases of cancer of the cervix into the following four classes representing the different stages of the disease.

Fig. 769.--Case of carcinoma of cervix uteri (squamous type) which has extended into the bladder and the rectum, causing a fistula from each of those organs into the vagina. (Kelly—*Operative Gynecology*)

Stage I. The growth is limited entirely to the cervix. The uterus is freely movable, and no paracervical infiltration can be detected.

Stage II. The parametrium is involved. The infiltration can be palpated under the vaginal wall or beside the cervix. The palpable infiltration may extend outward nearly to the pelvic wall, but the uterus still retains mobility. This stage includes the old "borderline operable" group.

Stage III. The parametrium is involved to the pelvic wall on one or both sides, with partial or complete fixation of the uterus.

Stage IV. The cancer has invaded adjacent viscera or extensively involved the vagina or produced distant metastases.

In the case of each patient, the evidences of the extent of involvement should be worked out sufficiently to permit accurate assignment to class. Accuracy is enhanced by deciding definitely as to the class at the time of examination and then recording the decision. This obviates the difficulty encountered when trying later to classify a borderline case with some needed detail missing. This accurate classification is best made during examination under

the analgesia for the radium implantation. Deep rectal palpation of the broad ligament of each side is most helpful in determining the fact and the extent of parametrial involvement.

For emphasis, it is well to repeat that a universal international classification is imperative for accurate comparison of the results of the various methods of treatment. The continued use of personal or provincial classifications, instead of the international one, interferes seriously with this comparison of treatment results, which means so much in the endeavor to give each patient the best chance of cure. Personal predilections as to the details of various stage-divisions should yield to the necessity of one universal and clearly understood classification. The League of Nations' classification is already widely used,

Fig. 770.—Case of carcinoma of cervix uteri in which the parametrial involvement has obstructed the ureters, causing serious dilatation of them and of the kidney pelves. (Kelly— *Operative Gynecology.*)

and it should be adopted in all countries by all workers. If anyone wishes to divide further one or more of the stages in reporting his cases, there is no objection to that— provided the subgroups are clearly defined and do not extend beyond the stage divided. For example, if one wishes to use Schmitz's division of early cases into (a) lesions 1 cm. or less in diameter and (b) lesions larger but still confined to the cervix, these subdivisions may be conveniently designated Stage I-a and Stage I-b.

Associated Diseases also add to the pathological picture in some cases. The advanced ulcerating growths are nearly always infected and may present sloughs at the vaginal vault. If the cervical canal is blocked there may be

771.—Early squamous carcinoma of cervix. Section through a diagnostic clipping from a suspicious area on the cervix. Gyn. Lab.
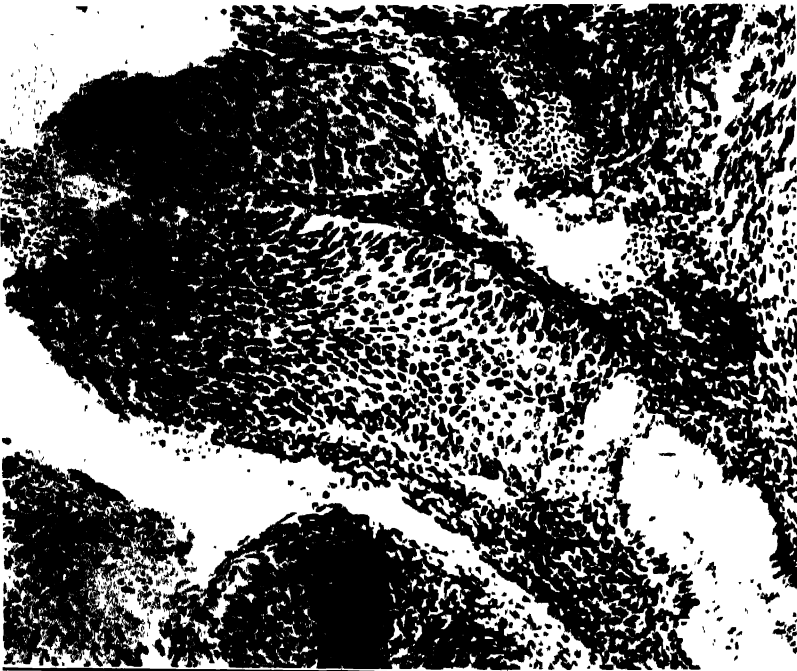
Fig. 772.—From the section shown in Fig. 771, illustrating the peculiar bud of abnormal cells, which has its own special blood supply. This is the reverse of the above photomicrograph. Gyn. Lab.
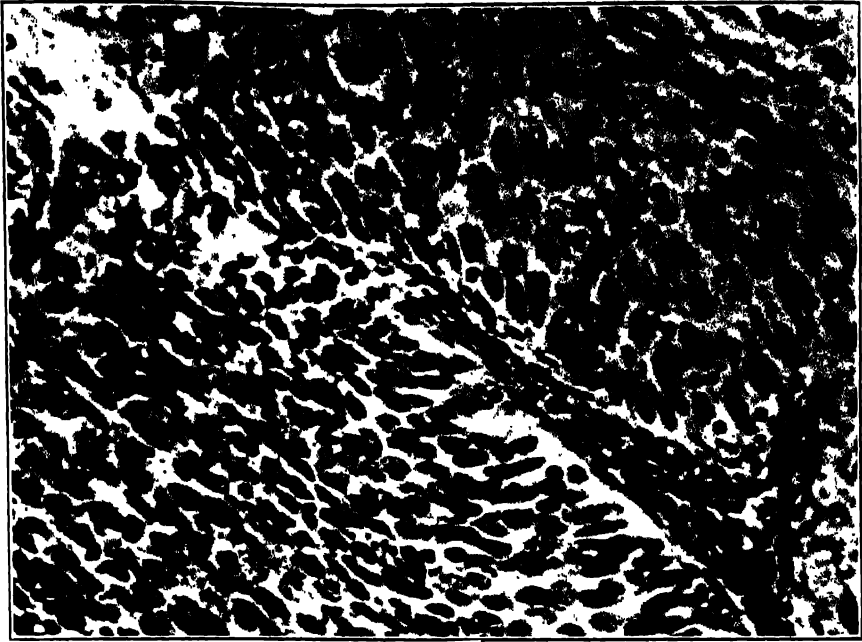
Fig. 773.—High power, showing characteristics of the cells and their distribution along the area of the blood supply. Gyn Lab.
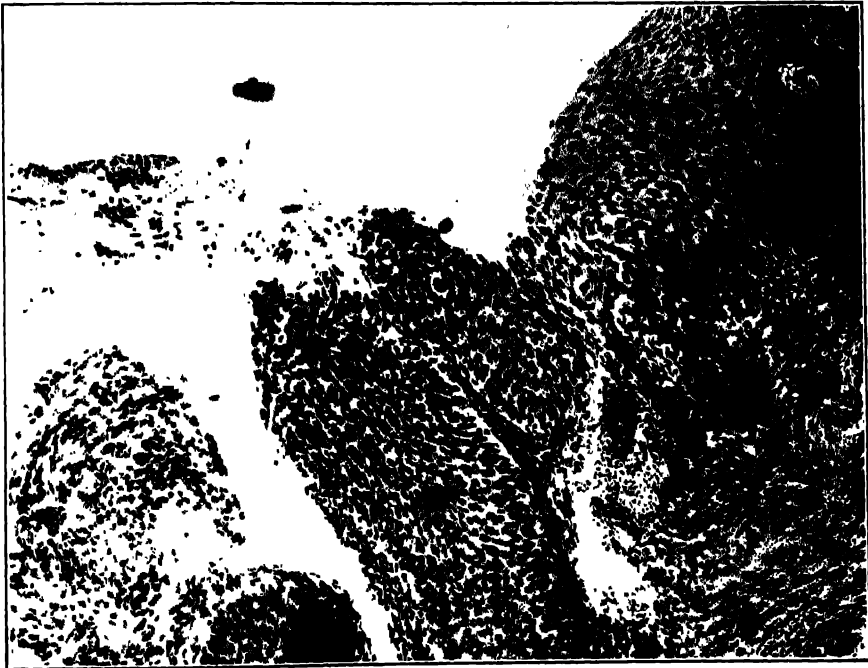
Fig. 774.—Another view of Fig. 771, showing the distinct junction line of the abnormal epithelium with the fairly normal, at the upper right portion of the field. Gyn. Lab.

pyometra above, with a thinned-out uterine wall. The inflammatory complications add much to the patient's distress and to the difficulties of palliative treatment.

Myoma may be a complication as shown in Fig. 733. *Pregnancy* is sometimes a complication. Carcinoma of the cervix may appear while the patient is pregnant, or occasionally pregnancy may take place in the early stage of carcinoma of the cervix. In either case the effect of pregnancy is to hasten the progress of the carcinoma. The softening of the tissues and the congestion associated with pregnancy seem to favor rapid extension of the malignant disease.

The duration of carcinoma of the cervix is variable, the limits ordinarily being from one to three years. The duration depends somewhat on the kind of tumor (the softer the tumor the more rapid the growth), upon the age of the patient (the younger the patient the more rapid the growth), and upon the proximity to childbirth—those carcinomas appearing within one year after parturition progressing very rapidly.

These are only general rules, to which there are, of course, exceptions.
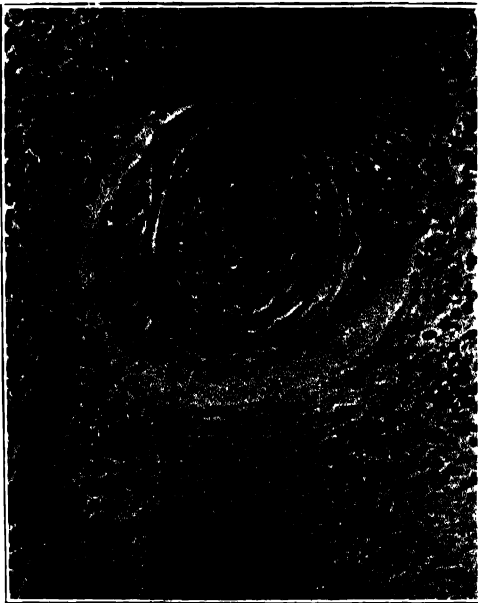
Fig. 775.

Fig. 776.

Fig. 775.—An epithelial pearl from a squamous carcinoma of the cervix uteri.

Fig. 776.—A carcinomatous plug growing within a cervical gland, the walls of which do not yet show carcinomatous change. From a squamous carcinoma of the cervix. Gyn. Lab.

Microscopic Pathology.—Various phases of the microscopic picture of squamous-cell carcinoma of the cervix are shown in Figs. 771 to 776. Fig. 771 shows an interesting young carcinoma in the form of a projecting bud. In Figs. 772 and 773 the higher magnifications bring out the characteristics of the cancer cells growing rapidly about a vascular core which nourishes them. Inspection of the right upper corner of the photomicrograph in Fig. 774 will show a line of demarcation between the cancer area and the comparatively normal epithelial covering of the cervix. The characteristic "pearl" formation is shown in Fig. 775, and carcinoma cells growing into a cervical gland in Fig. 776.

The **pathological classification** as to **cell type** of the squamous-cell carcinomas of the cervix gives three types or grades, arranged according to the average maturity-appearance of the cells.

Grade I. This is the spinal-cell type (Fig. 777). It is the most mature. The cells resemble those of the upper layer of the squamous epithelium. They are large with well-defined borders. The nuclei are large, but there is such an abundance of cytoplasm that they seem relatively small. The nuclei frequently contain a nucleolus, and they take a rather light blue stain. Pearl formation is common in this Type I class.

Grade II. This is the transitional-cell type (Fig. 778). The cells resemble the middle zone of the cervical epithelium. These cells are round or cuboidal in shape, with an ill-defined cell membrane. The nucleus is large in comparison to the cytoplasm, and it takes a deep hematoxylin stain.

Grade III. This is the fat spindle-cell type (Fig. 779). The cells are oval shaped, with a large nucleus and almost no cytoplasm. The cells are closely packed, and the nuclei stain darkly. These cells do not closely resemble any of the layers of the normal epithelium, but they are more like the basal layer than the other two.

These grades represent an ascending scale of malignancy, from the mature-cell slow-growing cancer to the immature-cell rapidly-growing type. Different cell-types may often be found in different parts of the same tumor, so the grading represents only the preponderating cell type. The immature cells are less resistant to radiation, and it was hoped that this pathologic grading could be used as an aid in selecting treatment, dosage, etc. This did not prove out, however, because of the uncertainty as to whether the diagnostic specimen represented the preponderating cell type in that case. The diagnostic-specimen grading may aid some in prognosis, for if grade III that shows at least part of the cancer has been growing rapidly with consequent greater chance of wide-spreading distribution.

There are certain **borderline conditions** which create much difficulty in the microscopic identification of beginning cancer. The questions as to when a chronic inflammation becomes precancerous, and at what particular stage it is definitely cancerous, have been debated for years among gynecologic pathologists.

These questions have been investigated by workers all over the world and many excellent articles have appeared in the American, German, and French medical literature. The need of a clear enunciation of the microscopic findings which warrant a diagnosis of early carcinoma has been emphasized in a paper by Schmitz, McJunkin, and Macaluso. These workers studied serial sections of chronic cervicitis. In some of the borderline cases they submitted sections to several eminent pathologists. The opinions for and against cancer were fairly evenly divided. When such a situation exists, it is obvious that serious mistakes may occur and that further investigation and standardization are urgently required.

It is in the **early microscopic picture** that the diagnostic difficulties lie—in the stage before the invasive break through the basement line, and long before there are any clinical symptoms that we associate with cancer. Most gynecologic pathologists now believe that definite cancer changes can be recognized in the epithelial cells before the break in the basal layer which marks invasion, though there are some who still feel that invasion is necessary before a diagnosis of cancer can be made. Martzloff holds this opinion, and he demonstrated in leucoplakia of the cervix the following points which commonly are used as criteria in the diagnosis of cancer: irregular size, shape, and staining reaction of the cells, loss of polarity, epithelial whorls, mitotic figures, and multinucleated cells. Leucoplakia presenting such cell changes, however, is itself under serious suspicion of beginning malignancy. In fact, Martzloff himself states that in some cases of leucoplakia the cells have all the characteristics of cancer except invasion. He makes the point, however, that invasive power is not proved until actually exhibited.
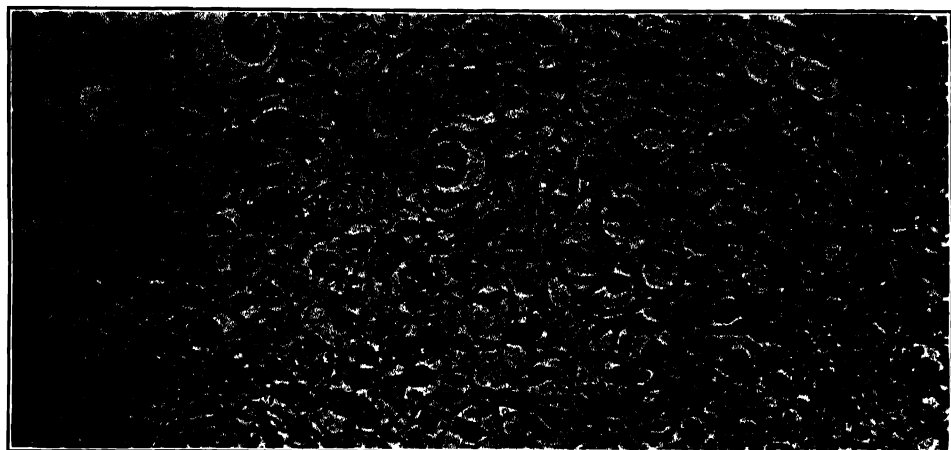
Fig. 777.—Squamous cell carcinoma of cervix. Grade I (spinal cell type). Gyn. Lab.
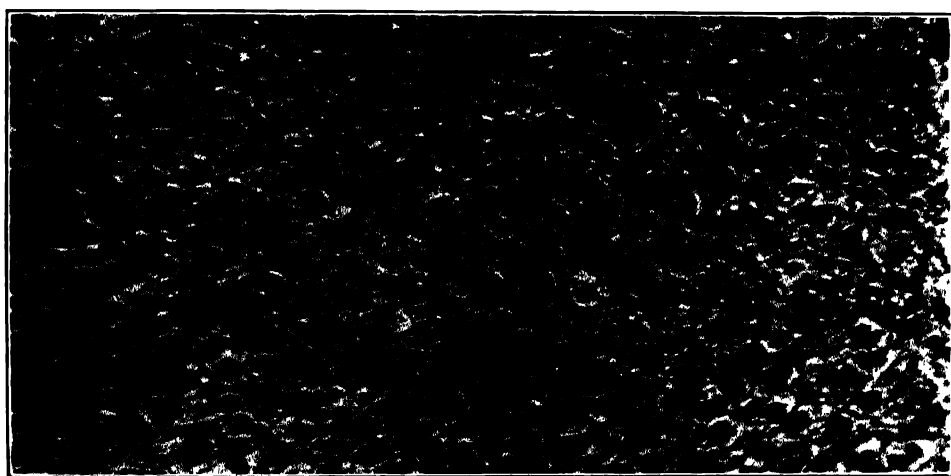
Fig. 778.—Squamous cell carcinoma of the cervix. Grade II (transitional cell type). Gyn. Lab
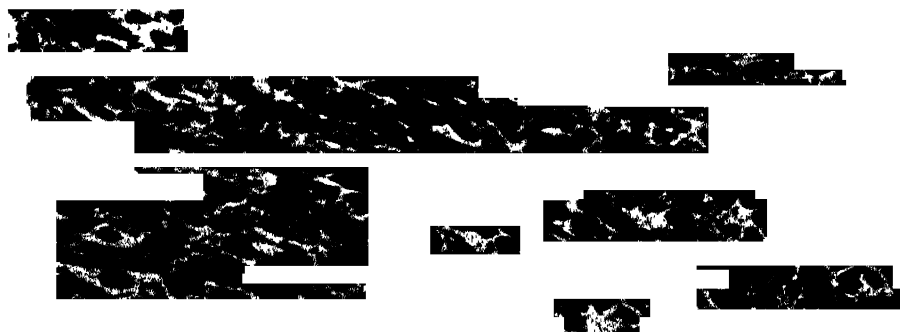
Fig. 779.—Squamous cell carcinoma of the cervix. Grade III (fat spindle cell type). Gyn. Lab.

Broders shows a striking example of epithelial cancer of the cervix still limited to the epithelial area (Fig. 780). Smith and Pemberton show the loss of the basal layer in Fig. 781-*A* and *B*.

In this connection, the line of junction of the cancer epithelium with the normal epithelium is an interesting area for study, as it shows the early cell changes in invasive cancer before the erratic activity has reached the basement line. Norris calls attention to this line

Fig. 780.—Squamous cell carcinoma in situ of the uterine cervix, in which the carcinomatous cells have replaced the normal cells and are appearing to function in a protective manner. There is no penetration of the so-called basement membrane; therefore, according to older teaching, the growth would be considered noncarcinomatous, or at most only precarcinomatous. (Broders—*J. A. M. A.*)

A.
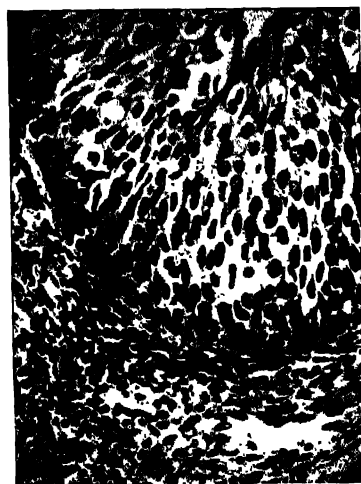
B.

Fig. 781.—Carcinoma cells with the basement layer gone. *A,* The advancing cell columns *B,* Higher power, showing the character of the cells. (Smith and Pemberton—*Surg., Gynec. and Obst.*)

of junction, as shown in Fig. 782. This section shows that the cancer changes in the cells may become quite advanced before they break through the basement line.

Incidentally, these slides show that the cell changes are more marked in the higher layers than in the basement area, which lends support to Montel's contention that the cancer originates in the upper layers of the epithelium. Montel holds that the basal layers being

intact in beginning cancer change indicates that squamous-cell carcinoma originates in the superficial layers, instead of in the basal layer, as held by Schiller.

In Fig. 783 is shown leucoplakia with erratic cell changes pronounced benign, which ten months later had advanced to invasive cancer (Fig. 784). Such experiences, along with the other facts cited, show the difficulties of the diagnosis of malignancy in borderline lesions of the cervix.

Stevenson and Scipiades reported eighteen cases of "noninvasive potential carcinoma" of the cervix, that is, presenting the cell changes usually considered indicative of cancer but without actual invasion. The potential invasive quality was shown by the fact that actual invasion later took place in two of the cases. In one of these two it was delayed for eight years, when the patient returned to the clinic with advanced cancer of the same cell type, which caused death in spite of active treatment.

Present information on this subject indicates that early cancers of the cervix may be divided into two groups, representing two stages in progress. First, there is the stage of epithelial change, which carries the epithelium from a group of normally functioning cells through the various erratic changes cited to the point where they are ready for
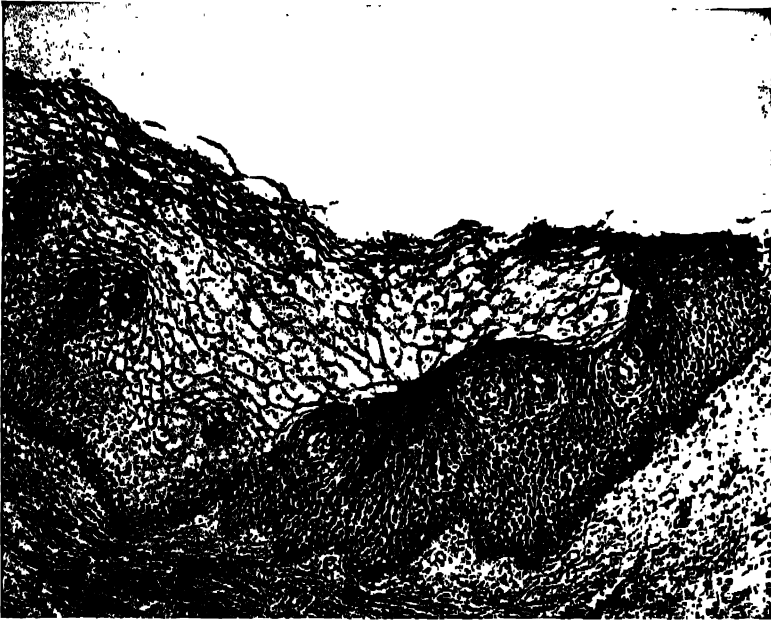
Fig. 782.—Early epidermoid carcinoma of the cervix, showing a clear-cut line of demarcation between the malignant and benign epithelium. This line is oblique due to the more rapid growth of deeper layers of the tumor. The cells of the latter exhibit the usual alterations in morphology characteristic of carcinoma. As is not unusual in some carcinomas, the basal layer is moderately well preserved. (×80.) (Norris—*Am. J. Cancer.*)

the invasion. Second, there is the stage of invasion, where the gradually developed abnormal cell activity and resulting products have so weakened the underlying tissue that invasion begins. Both of these stages are microscopic, and give no clinical disturbance which would arouse suspicion of malignancy, except evidence of some cervix irritation.

While it is clear that the real cancer cells (i.e., those which show their malignancy by invasion later or in another part of the same specimen) go through these two stages of progress, it seems clear also that not all cell groups showing the first stage pass to the increased erratic activity of the second stage (stage of invasion). The problem now is to distinguish between the erratic cells which are early cancer cells and the erratic cells which are essentially benign as far as future invasion is concerned.

Study of information available, including articles by Novak, Freedman, Smith and Pemberton, Broders, Norris, Henriksen, Schmitz and Benjamin, TeLinde, Hofbauer, Bailey,

Schiller, Stevenson and Scipiodes, and others, indicates that in the microscopic diagnosis of beginning cancer the following points should be taken into consideration:

1. Irregularity of cell arrangement—loss of "polarity." Loss of normal three layers.

2. Abnormal crowding of the cells.

3. Irregular staining of the cells with an increased avidity for basophilic stains.

4. Irregularity in the size of the cells and their nuclei. Occasionally giant cells are present.

5. Atypical or pathologic mitoses. The frequent appearance of mitotic figures in the field is significant, as indicating abnormally rapid cell multiplication. This point was emphasized by Cullen who, remarking that, of course, some mitosis must occur in normal growth and repair, stated that in his extensive histologic studies in the cervix, frequent mitoses were rarely encountered except where malignancy existed.

On the other hand, Henriksen found that in the normal cervix, "Mitoses and hyperchromatosis are more frequently present than most observers have noted."
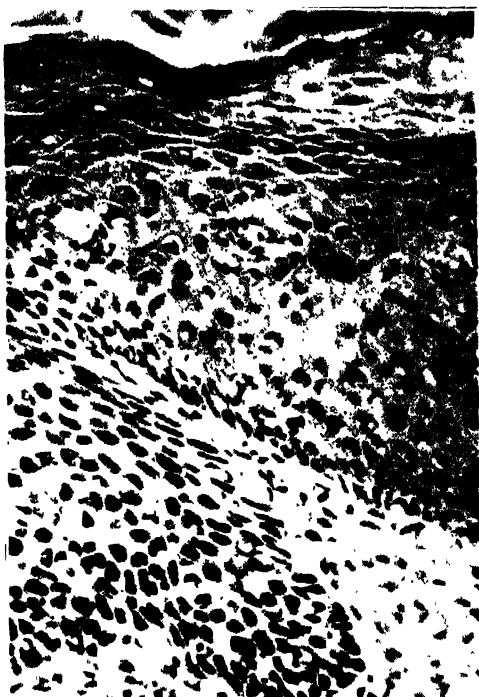
Fig. 783.

Fig. 784.

Fig. 783.—Leukoplakia of the nonkeratizing epithelium of the portio vaginalis at the lip of the uterine cervix. Hyperkeratosis, parakeratosis and the formation of a well-defined stratum granulosum are shown. Intercellular, intranuclear, and perinuclear edema with variations in size and shape of the cells and hyperchromatism are present in the stratum spinosum and stratum germinativum. Reduced from a photomicrograph with a magnification of 475 diameters.

Fig. 784.—Primary epidermoid carcinoma of the uterine cervix from a biopsy specimen taken ten months after removal of tissue illustrated in Fig. 783. Neoplasia, anaplasia, and hyperchromatism with numerous mitotic figures are shown. Other fields show attempts at pearl formation. Reduced from a photomicrograph with a magnification of 500 diameters. (Schmitz and Benjamin—J. A. M. A.)

In addition to the unusual number of mitoses, there may be abnormalities in the mitotic configurations, indicating erratic distribution of the chromosomes. Figs. 785 to 791 show the normal mitotic figures for the various phases of normal cell division alongside an abnormal mitotic figure for each phase.

6. Marked round-cell infiltration. This is stressed by Smith and Pemberton, as are also dilated capillaries and indistinct basal layer.

7. Special blood supply developed by the suspicious group of cells. In one of our cases, a specimen from the cervix showed one suspicious slide, which was pronounced early carcinoma by Prof. O. H. Schwarz, largely on this account. Fig. 772 shows the bud of

abnormal cells still limited by the basement line. It may be studied further in Fig. 773. The central area of this growing bud shows that these cells in their erratic activity are developing a blood supply quite out of the ordinary in this region. In another part of the slide there was a disturbed area which might be invasion, but it might also be an artefact, so the diagnosis was decided largely by this interesting bud of abnormal cells creating an unusual blood supply.

On account of the borderline features with only questionable invasion, this slide was sent to several pathologists, and different opinions were received, a number of them against cancer. In the meantime, a conical excision of the cervix was made to obtain the whole region for microscopic study. This showed an area of carcinoma with frank invasion.
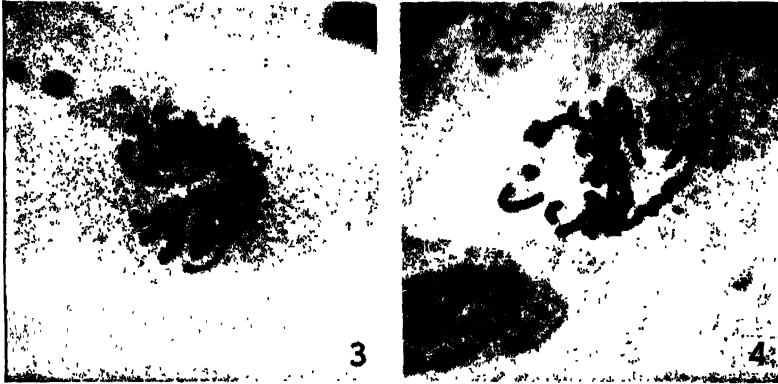
Fig. 785.—*3*, Early prophase of a normal cell division. *4*, Early prophase, showing i this stage a delay in the regular formation which does not occur in normal cell division.- (Mendelsohn—*Am. J. Cancer.*)
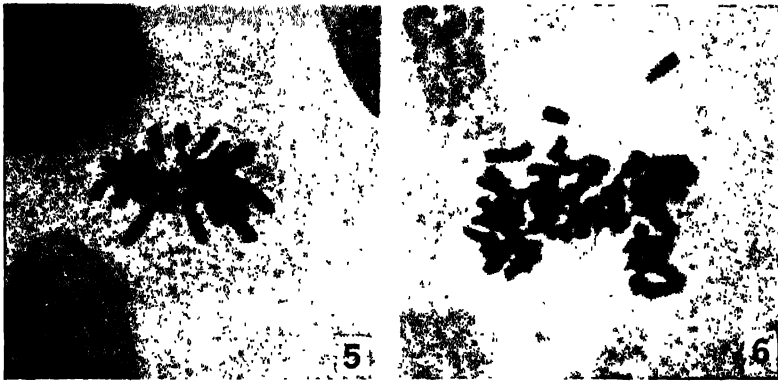
Fig. 786.—*5*, Early metaphase of a normal cell division, showing the splitting of the chromosomes in the regular way. *6*, Early metaphase, showing a greater number of chromosomes than normal. Also, one chromosome is slow in reaching the metaphase plate and may not get into this mitosis. (Mendelsohn—*Am. J. Cancer.*)

8. Novak quoting Meyer emphasizes the point that in chronic cervicitis and erosion the invasion of the squamous epithelium follows the trellis furnished by the glandular framework, while in cancer the invasion does not necessarily bear any relation to the glands.

This calls attention to another factor in the difficulty of carcinoma diagnosis, namely, *epidermization*, which in this situation is usually of the extension type. The "creeping" of squamous epithelium under columnar epithelium and replacement of the latter is an important factor in the regular healing of cervical erosion. Epidermization deeper in the cervix seems to be an extension of this process to areas normally occupied by columnar epithelium. For an understanding of the process and the resulting microscopic character- istics, it would be well to review the text and illustrations under Erosion. Its extension to situations where it complicates the diagnosis of carcinoma is shown in Figs. 792 to 794.

In the differential diagnosis of epidermization, two points to keep in mind are: (1) that individual cell characteristics do not go beyond those of normal growing cells and (2) that the penetrating cells are distributed within the framework of the glands.

Fig. 787.—7, Metaphase of a normal cell division, showing the chromosomes more widely split in regular fashion. 8. Metaphase showing four chromosomes which have failed to assume their usual position on the metaphase plate. When this cell completes division, these four chromosomes will become aberrant. (Mendelsohn—*Am. J. Cancer.*)
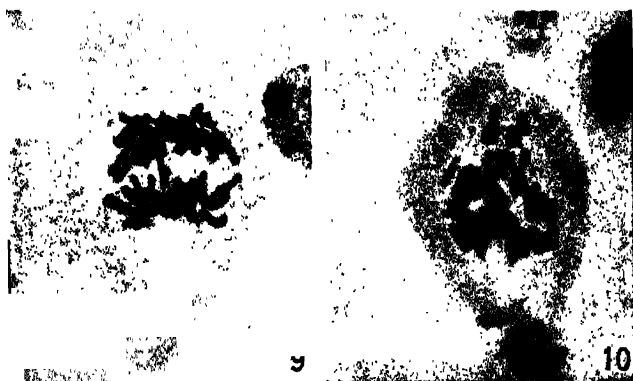
Fig. 788.—9, Anaphase of a normal cell division. 10, Anaphase showing a number of aberrant chromosomes which failed to enter the metaphase plate. These chromosomes will be taken up by one daughter cell and may either enter the new nucleus or else round up as a small chromosomal vesicle. This illustrates asymmetrical mitosis with unequal distribution of chromosomes. (Mendelsohn —*Am. J. Cancer.*)
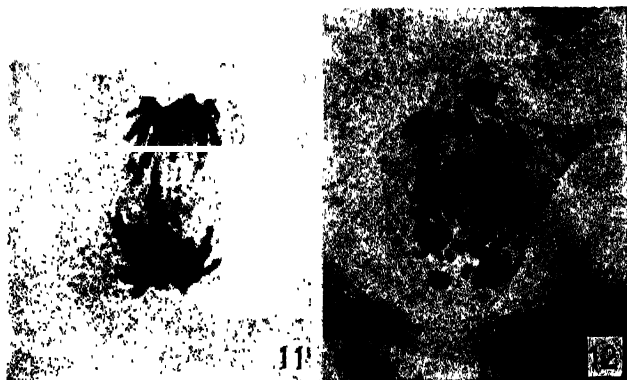
Fig. 789.—*11*, Telephase of a normal cell division. *12*, Telephase showing a marked delay in the movement of the chromosomes. Although many chromosomes have reached the poles, there are many more still separating at the metaphase plate. It is quite possible that mitosis will not be completed and a cell will result with double the number of chromosomes. (Mendelsohn—*Am. J. Cancer.*)

In addition to the regular and essential elements of the diseased tissue, there are **secondary changes**. Areas of softening and degeneration occur in which the cells are broken down and become simply fluid and débris. Hemorrhage into certain parts of the growth may occur and, as a result of that
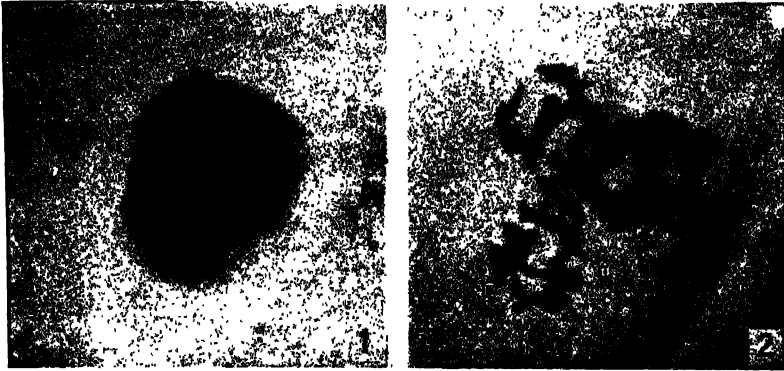
Fig. 790.—*1*, Early telephase of a cell which will divide into three daughter cells. It has three poles but only two spindles. The daughter cells will have an unequal distribution of the chromosomes. *2*, Early telephase of a cell which will divide into three daughter cells. This one has three poles and three spindles. The spindle fibers do not show clearly. Each daughter cell will have more chromosomes than those in *1*. (Mendelsohn—*Am. J. Cancer.*)
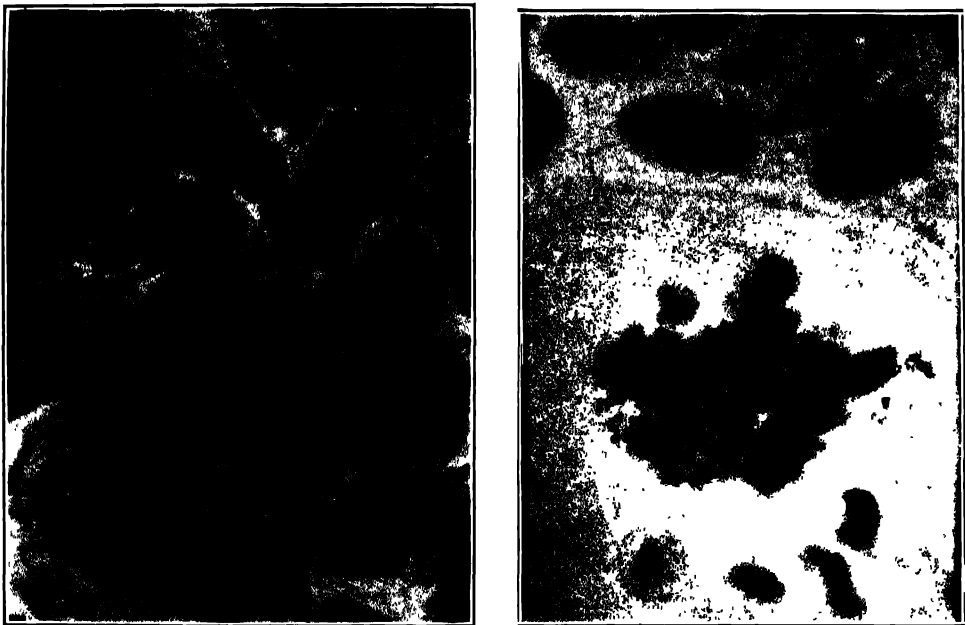
Fig. 791.—Abnormal mitoses. The photomicrograph to the left shows the so-called "Y" type of mitosis, and the one to the right shows the "H" type. In the case presenting these mitoses, the specimen consisted only of scrapings from the suspicious area of the cervix, and there was no piece of tissue large enough to show relations. The diagnosis had to be made from the cell characteristics, and these abnormal mitoses aided materially in the diagnosis of malignancy. The condition proved to be a squamous cell carcinoma. Gyn. Lab.

hemorrhage, there remain clots and discoloration and fluid. Infection may take place, leading to suppuration or sloughing. Occasionally lime salts are deposited in the cancer cells. This chalky deposit may be extensive and may even be found in the metastases.

Modes of Extension.—Carcinoma of the cervix extends in four ways—by continuity of tissue, by lymphatics, by the blood stream, and by implantation.

Extension by **continuity of tissue** is the principal method and, aside from exceptional cases, the only method in the earlier stages of the growth. In this method of extension, the carcinoma cells grow into the tissues against which they lie. This differs markedly from the way in which a nonmalignant tumor extends. A myoma as it grows pushes aside the adjacent tissues, but a malignant tumor as it grows *penetrates* the adjacent tissues and destroys them.

Fig. 792 —Showing, above and to left, a nest of epithelial cells resulting from an advance of epidermization process, the gland lumen being entirely filled, and the columnar epithelium being choked off. The gland below this, and also the one to the right, shows a less advanced stage of the same process, with some of the columnar cells still persisting. In lower left-hand corner is a fenestrated gland picture, produced by a combination of the same change with the adenomatous reduplication of the cylindric epithelium often seen in inflammatory lesions. No evidence of malignancy in any of these areas. (Novak—*Am. J. Obst. and Gynec.*)
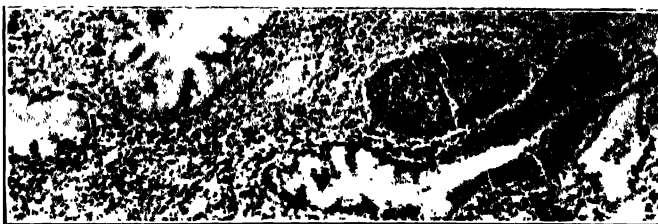
Fig. 793.—Early squamous cell cancer in a patient with only suspicious cervical lesion in which no biopsy was done. The diagnosis was made after and not before the operation, as might have been done. Note the difference between these cell nests and those shown in Fig. 792. Under the high power the cells are seen to be closely packed, placed chiefly like palisades perpendicularly to the basement membrane, and showing the usual cancer characters, mitoses, hyperchromatosis, etc.). The cell nests here are independent of the glands, although of course glands are often invaded in cancer also. (Novak—*Am. J. Obst. and Gynec.*)

It is this insidious involvement of the contiguous tissues that makes most cervical carcinomas inoperable when first seen. It is this same gradual extension outward by continuity of tissue that later causes the patient most of her suffering and that in most cases causes her death by compressing the ureters, as shown in Fig. 770, and destroying kidney function.

In extension **through the lymphatics,** some carcinoma cells are caught in the lymph current and carried to lymphatic glands, where they lodge and grow and destroy tissue the same as the parent growth.

Winter found cancerous glands in only 2 cases in 44 autopsies on patients where the disease was confined to the uterus. Wertheim, in 60 operated cases, found involvement of removed glands in 15 per cent of early cases and in 31.7 per cent of all cases. Schauta made a most thorough autopsy study of 60 cases, in 40 of which the patients died from the natural effects of the cancer and in 9 from intercurrent affections. In 43.3 per cent of the whole series, the glands were entirely free of carcinomatous metastases. The lower (removable) glands alone were involved in 13.3 per cent, the upper (not removable) glands alone in 8.3 per cent and both lower and upper glands in 35 per cent.

Kundrat, in a study of 76 patients operated on by Wertheim, in which the parametrium was involved on one or both sides, found the glands entirely free of metastases in 71 per cent. The glands on one side were involved in 22 per cent, and the glands on both sides were involved in 7 per cent.

The glands are rarely involved until the cancer has advanced into the parametrium. Kundrat, in his analysis of 80 cases, found only 4 in which the glands were involved with the parametrium free.

Fig. 794.—Section from the uterine cervix, showing inflammatory metaplasia or epidermization on one lip (left) and definite cancer on the other lip (right). (Novak—*Am. J. Obst. and Gynec.*)

Enlargement of the regional glands is very common in the early stage of carcinoma but this enlargement is, as a rule, not due to carcinoma cells but to the inflammatory hypertrophy that nearly always takes place in the glands draining a region that is subject to severe chronic irritation. In exceptional cases, however, the glands may become infected with carcinoma cells at an early stage of the disease.

This matter of glandular involvement has a very important bearing on the question of operative treatment.

In extension **by the blood stream,** some carcinoma cells penetrate into a blood vessel, are caught in the current, and are carried to distant organs, where they lodge and grow and form metastatic tumors. In whatever kind of tissue

these metastatic growths are situated, they reproduce the structure of the parent growth. The lungs are most frequently affected, though there are many other organs that are affected occasionally. The possibility of metastases must be kept in mind in deciding whether or not a case is operable. If metastasis to distant organs has occurred, hysterectomy would, of course, be useless, except as a palliative measure. Such metastases, however, hardly ever occur except in the last stage, and then not very frequently. Winter, in 202 cases, found metastases in distant organs in only 2.5 per cent.

Direct Implantation of cancer cells into the healthy tissues of a raw surface takes place principally in operations for cancer—the cells being carried on the knife or scissors or other instrument, or on the fingers or sponges, from the infiltrated area to the healthy tissue which has been laid open in the operative work. Many undoubted instances of this occurrence are on record. It furnishes a strong reason for devitalizing cancer cells by radiation before operation and keeping the line of excision outside involved tissue during operation as far as conditions will permit.
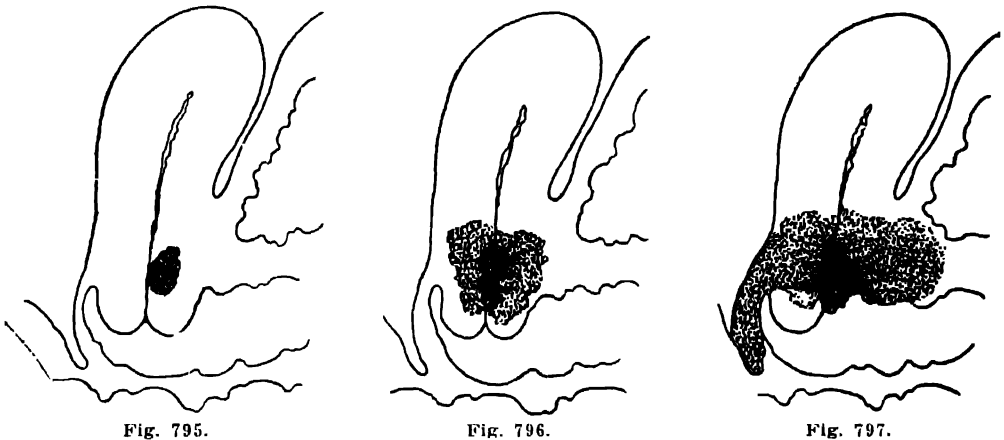
| Fig. 795. | Fig. 796. | Fig. 797. |

Figs. 795 to 797.—Progressive development of an adenocarcinoma of the cervix. Fig 795 originates from a gland within the cervix, in contradistinction to squamous carcinoma which originates from the squamous epithelium on the vaginal portion. Fig 796. Extension throughout the greater part of the cervix. Fig. 797. Extensive involvement of pericervical tissues.

PATHOLOGY OF ADENOCARCINOMA

This type of cancer of the cervix arises from the columnar epithelium lining of the cervical canal and its glands. It comprises about 3 to 10 per cent of the cervical carcinomas. Healy found only 2.7 per cent in 1,574 cervical cancers. Cullen found 12.9 per cent in his early series. In our early series of 121 cases of cervical carcinoma 4 (about 3 per cent) were adenocarcinoma.

As adenocarcinoma is inside the cervix (Figs. 795 to 797), its presence is not appreciated until it has advanced sufficiently to cause bleeding or discharge which leads to investigation inside the cervix. The disease runs much the same general course as described for squamous-cell carcinoma, the cancer cells penetrating deeper and deeper into the cervix and out into the parametrium. After a time the cancer may extend to the external os, as a small swelling or as a papillary projection. The induration gradually extends and in time the pelvis becomes occupied by a firm fixed mass of infiltrated tissues, involving
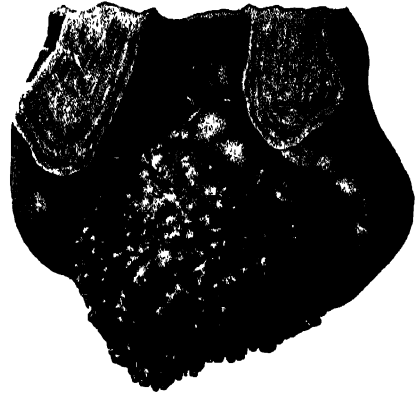
Fig. 798.—Adenocarcinoma of the interior of the cervix. A small swelling at the widened external os. (Sampson—*Bull. Johns Hopkins Hosp.*)

Fig. 799.—Drawing from an adenocarcinoma of the cervix forming a small projecting papillary mass. Part of the cervix has been removed to show the connection of the papillary mass with the cervical wall. Gyn. Lab.

Fig. 800.—Still more advanced carcinoma of cervix (adenocarcinoma), ureters involved. (Kelly—*Operative Gynecology.*)

the parametrium to the pelvic wall and the rectum and the bladder. In some cases the ureters are gripped and constricted. Various stages in adenocarcinoma are shown in Figs. 795 to 800. Occasionally the cervical canal becomes completely blocked, with pyometra above from the accompanying infection.

Microscopic Pathology.—Adenocarcinoma of the cervix arises from the cylindrical cells lining the interior of the cervix and forming the cervical glands. It may then in the beginning be located near the external os in the cervical canal or in any part of a gland extending deeply into the cervical wall. As the cell columns penetrate the underlying tissues, the cells assume somewhat a gland formation owing to this derivation from gland-forming epithelium. This gland formation, however, is very irregular and atypical, being represented to a large extent only by solid columns of cells.

Fig. 801.—Adenocarcinoma of the cervix uteri. This photomicrograph is from the growing edge. Notice the normal glands and the carcinomatous glands in the same field. Gyn. Lab.

Microscopically, three groups are noted. In the first the glands are well differentiated and the only signs of malignancy are in the atypical cells lining the glands. The basement membrane is not broken, and the cells may be only a single layer thick. The glands are usually very irregular. In the second group are those cases in which there is definite invasion of the underlying muscle by irregular distorted glands. The lining cells are piled up in many layers and are themselves atypical cells. Mitoses are frequent. There is, however, a definite tendency toward gland formation. In the third group, the cellular growth is solid, with no attempt at gland formation. These are sometimes very difficult to distinguish from squamous-cell cancer, particularly if there is much associated epidermization.

Fig. 801 shows an adenocarcinoma of the cervix with glandular patterns.

Metastases.—These cancers metastasize early, because they are endophytic (ingrowing) rather than exophytic (outgrowing on the surface).

Symptoms

Study of the information given under pathology, gross and microscopic, will enable one to appreciate that *beginning carcinoma* of the cervix is *symptomless*. It is only after the carcinoma has advanced to tissue destruction that the telltale occasional spot of blood is added to the slight leucorrhea of the chronic cervicitis.

This slight streak of blood is seen usually after extra exertion (extra work, long walk, lifting) or after a douche or after coitus. It is especially liable to appear within twenty-four hours after coitus. A history of such "spotting" calls for a most careful examination, that the presence or absence of carcinoma of the vaginal surface of the cervix or of the interior of the cervix may be certainly determined.

In addition to the absence of any marked disturbing symptoms in the early stage of cancer, there is another factor leading to its escaping notice till too late and that is the tendency of some physicians to overlook the significance of minor cervix irritation, either as indication of possible beginning cancer or favoring late development of it. Though the splendid cooperation and continuous efforts of many organizations have brought marked improvement in both the above-mentioned directions, there is still necessity for greater exertions. This is emphasized by the information obtained through McDowell's careful survey and analysis of cancer diagnosis in one of our large metropolitan areas. Utilizing death certificates and case records he found 59 per cent of the fatal cases had been diagnosed as malignant less than six months before death, and 80 per cent less than a year. The significance of this is apparent when we remember that cancer is a slow disease, requiring two or three years to run its course. It means that many of these individuals *with advancing cancer* were treating themselves with home measures or receiving minor office treatment by a physician.

Diagnosis

An early squamous-cell carcinoma of the cervix is shown in Fig. 761. On the surface there is only a small spot of irritation, with no indication of the sinister growth spreading to the interior of the cervix and branching in various directions. Only the physician who is alert to the possibilities beneath a spot of irritation would find this young carcinoma. Others would treat the cervix for simple inflammation, with the hidden cancer racing to the parametrium and to the deep structures along the pelvic wall. There, in-brief, is stated and illustrated the physician's problem in the diagnosis of cancer of the cervix.

As we have seen, the pathologist has his problems in deciding whether or not a borderline microscopic picture is cancer, and as we shall see later, the public health official has the difficult problem of persuading people to consult the family physician for minor irritations and for examination to see if there is irritation not yet producing discharge, but we are concerned just now with what the examining physician must do to discharge the cancer responsibility he assumes when consulted by a patient complaining of some vaginal discharge or who comes for a general examination simply to know "if everything is all right."

In the first place, the physician must visualize to himself the possibilities in the situation on which he is giving responsible advice—advice on which the patient can place full reliance of future safety as far as present conditions are concerned. As an aid in this direction, I would advise the physician to think of the subject in such a way that, when consulted by a patient for examination, a picture similar to Fig. 761 automatically comes into the mind's eye. If it were not for the worry such graphic exhibit of facts might cause the patient, I would advise that an enlargement of this photomicrograph or some similar one be kept by the physician above his desk as he talks with the patient and assumes responsibility for her health.

There are two parts to the physician's task. The first part is to cause the patient to see the necessity of local examination, without causing her undue anxiety. This may usually be accomplished by explaining that there may be local irritation which has not advanced to the point of noticeable discharge but which nevertheless is a source of danger until eliminated. Hence the sensible thing is to determine whether there is any irritation and if so, eliminate it—then there is no remaining uncertainty nor occasion for worry. If the patient is one of those exceptional individuals who thinks the physician cannot have knowledge of possible conditions which she does not appreciate or see evidence of, the safest plan for the physician is to refuse to assume health responsibility for her. He has enough serious responsibilities to fulfill with the patients who cooperate, and it is better, on the whole, to lose a prospective patient occasionally than to assume responsibility blindly.

The second part of the task is to deal with conditions found on examination in a way definitely to exclude cancer, without causing the patient unnecessary trouble or expense. If the vaginal portion of the cervix is normal on inspection and there is no indication of trouble higher, that ordinarily suffices for the present. The patient is directed to return promptly if there should be any local disturbance any time. It is also explained to her that a general and local check-up at certain intervals, as a health assurance measure to catch any beginning disturbance in an early stage, is well worth the expense. The interval of probable safety varies, being usually put at six months or one year, depending on the condition of the complicated machinery and the local protecting surfaces in that individual.

This information as to the advisability of future examinations is an important part of the advice to the patient, and should be put in a way that she will appreciate the safety and reassuring satisfaction it gives her (rather than being anxious and frightened) and also in a way to make it clear that your responsibility cannot extend beyond the limits stated.

If the cervix presents irritation from cervicitis in any of its various forms, it must be dealt with adequately, which means (a) removal of the irritation and (b) definite determination whether or not there is any associated cancer. If conditions are such that these necessary requirements can apparently be met by a lactic acid douche and the simple office treatment measures already mentioned under Cervicitis, they are to be employed.

If the irritation does not clear promptly under this treatment, or if on first examination the irritation appears of chronic type not likely to clear

promptly, then conization should be carried out in a way to remove the whole affected area—that is, by the electric cutting-wire or the knife, as explained in detail under Cervicitis in Chapter VII. Endometrial curettage also is usually advisable in these cases, and if needed, vaginal plastic work may be carried out at the same time. The expense of conization and curettage with its few days' hospitalization, is a small price to pay for the elimination of irritation that may lead to cancer and the determination as to whether or not that disease has already begun. It is to their honor, and a justification of the implicit confidence of their patients, that physicians seek to spare the patient trouble and expense. But this kindly feeling can be carried to a point where it may do the patient irreparable harm. It is no kindness to a patient to give her the comfortable feeling that a small lesion carries no danger, and then have her return to you or to some other physician after a few months with an advanced cancer of the uterus or of the breast, as the case may be. The danger of such result from your consultation lies in the patient's interpretation of what you say and how you say it. Consequently, it is important to overcome the natural tendency to give desired assurance sufficiently to leave no loophole by which the patient may reason that there is no danger or that she can safely postpone the next visit or the additional examination and treatment measures you mentioned.

The evidences of advanced cancer have been sufficiently mentioned under Pathology and Symptomatology. They hardly belong under Diagnosis—the time for diagnosis is long before that.

Adenocarcinoma creates a special diagnostic problem in that it occurs inside the canal, which area is not visible on speculum examination. If there is a history of occasional show of blood or a discharge, with nothing about the vagina or vaginal surface of cervix to account for it, the solution of the problem is clearly indicated, namely, to carry out regular curettage and conization. This provides effective treatment for the bleeding or discharge, whether it comes from the endometrium or the cervical mucosa, and at the same time gives adequate specimens for determining with certainty whether or not there is beginning cancer in either location.

The other phase of this diagnostic problem is furnished by the patient who comes simply for a safety check-over and has no bleeding nor discharge nor other evidence of trouble in vagina or uterus. Of course we have been inclined hitherto to feel that, with the vagina and vaginal portion of the cervix free of irritation on inspection and no indication of trouble higher, we could safely assure the patient of normal conditions. But developments have raised a serious doubt.

The early diagnosis of endocervical cancer has the same requirements as the early diagnosis of cervical surface cancer, namely, that it be discovered *before* it has advanced to the stage of bleeding or discharge. These two so-called "early" signs mean a break in the surface (ulceration) and we know that in many cases the carcinoma penetrates deeply, by lymphatic or blood-vessel penetration or even by adjacent tissue involvement, while still protected by surface epithelium. Detection of cervix cancer in a really early stage requires removal of every spot of persisting irritation, and microscopic check-up

of it. We can see the spot of chronic irritation on the vaginal surface of the cervix but not the spot of chronic irritation inside the canal—hence the added problem.

The peculiarity of the endometrium, with its vascular phenomena resulting in normal bleeding and cast-off every few weeks, makes it particularly responsive to irritation whether on the surface or underneath, and consequently endometrial cancer is signalized early by increased flow or intermenstrual spotting, which the examiner can appreciate. An endo-metrial cancer patient who comes late, does so because the patient or the physician did not appreciate the possible sinister significance of irritation signs. But the endocervical cancer may give no early irritation sign, and yet we are required to decide whether or not a spot of irritation is present.

We desire to avoid causing the patient unnecessary trouble. On the other hand, this serious decision cannot be passed over lightly with wishful thinking and a reassuring guess. Some meet this problem by advising conization as part of the regular pelvic examination in patients past a certain age. At first thought this may seem unduly radical, but on second thought we must realize that a reasonably certain elimination of cancer or its early detection if present is well worth the expense and trouble of conization or of more extensive pro-cedure if necessary.

We must not be lulled into false security by the fact that adenocarcinoma furnishes only about 5 per cent of cervix cancers, for squamous-cell cancers also occur in the canal, where the squamous epithelium extends up inside to meet the glandular epithelium. Wollner cites such a case in his instructive report on a series of cases on which he carried out routine conization for the purpose of systematic histological investigation. In fifty-nine patients, without symptoms or clinical findings indicating malignancy, in which he did conization he discovered carcinoma in two. In one of these the beginning carcinoma was inside the cervical canal but of the squamous-cell type, starting from the squamous epi-thelium in the lower part of the canal. He concludes that: (1) Conization should accom-pany curettage as a diagnostic measure, holding that curettage does not remove sufficient tissue from the cervical mucosa for conclusive microscopic investigation. (2) Every woman past the age of thirty should be considered as possibly harboring a beginning cancer of the cervix, and a conization tissue-examination is advisable to detect or eliminate the condi-tion. In addition to the benefit to the individual patients this would result in the accumu-lation of histological studies contributing greatly to a better understanding of the physi-ology and pathology at a common site of carcinoma.

In adenocarcinoma, childbearing is not the important factor that it is in the squamous-cell type. Consequently the safety examination of the canal is advisable in the nullipara and in the unmarried of cancer age. Lash found an unsuspected adenocarcinoma of the cervix in a virgin of forty. It was discovered by removal of the uterus for myoma. There had been some bleeding, which was attributed to the obvious myoma. This carries the additional warning that a bleeding tendency with a myoma may be due to an associated cancer instead of the myoma.

There are **two encouraging features** that should be remembered along with the difficulties of early cancer diagnosis. When this really early diagnosis is made, cure is almost certain, running 95 per cent and higher where indicated radical measures are employed promptly. Again, recent investigations indi-cate that the period during which this early microscopic diagnosis may be made is a comparatively long one. The erratic cell changes cited and illus-trated may continue many months and in exceptional cases some years before the break through the basement membrane and invasion of underlying tissues. Knowing of this long period for genuine early diagnosis by the methods men-

tioned, before symptoms or even subepithelial invasion, and viewing the steady stream of deaths from cervix cancer in the past, one can say, in looking back "What opportunities we lost!" and looking forward "What splendid promise for the future!"

Treatment

The principles of present-day treatment of this disease were summarized as follows by the senior author in an invited editorial, for the *American Journal of Surgery*, entitled "Treatment of Cancer of the Cervix Uteri:"

The most important advance in the treatment of cancer of the cervix is the shift from operation to irradiation. This change has been going on gradually for some years, and is now almost complete among the leaders in gynecologic work. Even those few who still employ radical operation, do not depend on the operation but use irradiation also in some form to reach the outlying cancer cells.

Despite the variety of classifications used and the consequent difficulties of critical comparison of results from operation and from irradiation, there is already apparent a definite statistical balance of cure-rate in favor of irradiation. And that is only part of the story. The radical operation has been developed practically to its limit, while irradiation is young and still developing rapidly. Again, irradiation can rescue many patients who have passed far beyond the reach of operation. Again, when depending on radical operation it is necessary in even the earliest case of cancer of the cervix to subject the patient to very grave risk, whereas with irradiation the patient is given a better chance of cure with much less risk in all stages.

My conclusions in this important matter were not reached hastily, but through critical study and a long experience of practical participation in radical operative treatment and in radical irradiation treatment for this disease. I deal with the subject from the standpoint of the practicing surgeon, anxious to give his patient every possible chance for life. There should be no antagonism of the surgeon to radium. It is simply another helpful instrument added to his armamentarium.

Effective irradiation treatment of cancer of the cervix is serious and hazardous surgical work. The shift of instruments from the knife to the more deeply penetrating radium does not lessen the surgical responsibility. If the dosage employed is too large for the particular conditions present in the pelvis, serious injury to important organs may result. If the dosage is too small, the patient is not given the chance for life to which she is entitled. The maximum dosage possible in a given case depends on a number of factors, including the location and size of the cancerous mass, the amount of involvement of each of the organs in the immediate vicinity, the extent and direction of ulceration, and the amount of fixation of the bladder and rectum by the carcinomatous infiltration. The accurate determination of these conditions and the utilization of that knowledge in effective radium treatment, require a large amount of experience and skill in pelvic work. While in some situations the radiologist without special local knowledge may give effective radium treatments, in carcinoma of the cervix conditions are such that the most effective treatment can be given only by one with special gynecologic training as well as radium training. His special knowledge of pelvic anatomy and pathology and his training in accurate pelvic palpation and diagnosis must all be utilized in the supreme effort to reach the marginal cancer cells with effective radiation.

There is a tendency among the inexperienced to regard the use of radium lightly. This tendency is encouraged by some of the radium-rental instructions given by commercial companies, which presume to fit the recipient for the safe and effective use of this dangerous instrument. It would be as reasonable to suppose that instructions issued with a scalpel would fit the recipient to use it safely and effectively in the eradication of cancer. Radium is as potent as the knife, and in inexperienced hands may produce as disastrous results, either in the form of injury to adjacent organs or as failure to save a life which might have been saved by effective use.

Of course, irradiation treatment does not exclude any work with the knife which may be helpful. In special conditions some vaginal operation or abdominal operation may permit more advantageous placing of the radium in its various forms. The important point in regard to any operative work employed, is that it should supplement irradiation and not displace it. Another important point is that any experimental work, not established by a record of five-year cures, should be presented as experimental only. Otherwise it may be accepted and used by the uninitiated as an established method of cure.

The most pressing problem just now is to bring the benefits of radical irradiation treatment to patients generally. The spread into general practice of this most effective treatment for this disease is very slow. There are reasons for this. In the first place, cancer of the cervix is very deceptive as to the extent of the lesion and the depth of penetration. What appears to be an early cancer of the uterus is really already a cancer of the outlying pelvic structures, for whose elimination hysterectomy as ordinarily performed is but a futile gesture.

A second stumblingblock to the general adoption of the most effective treatment is that many physicians find it difficult to understand how any other treatment could be more effective than operative removal. Now, while operative removal is effective as far as it goes, in most cases of cancer of the cervix it cannot go far enough to remove the outlying cancer cells. When only one patient in four can be saved by the most radical operation by the most experienced pelvic surgeons, what chance of cure has the patient with this widespread disease when subjected to operation by an operator inexperienced in this deep work in this difficult situation? The result as a rule is removal of little more than the uterus, leaving the deeper portions of the growth to progress and eventually cause death. Dependence on such incomplete operation deprives the patient of the chance for life which modern treatment would give her.

The treatment given patients with cancer of the cervix in any community is determined largely by the surgeons of that community. In every case the decision as to the type of treatment is a serious matter, for it may mean the difference between life and death for that patient. Hence the importance of the clear presentation, by the educational agencies of the profession, of the superiority of expert radical irradiation for this disease.

It seems to me that the clearness of such educational presentation and its effect in securing such treatment for these patients, are both diminished by coincident attractive delineation of the radical operation, with its wealth of pictorial detail which appeals so strongly to the uninitiated. Actions speak louder than words, and my feeling as to the importance of this matter is shown by my declining, as per the following letter, an invitation to present the radical operation for the symposium in this issue.

St. Louis, Mo., Nov. 27, 1934.

Dear Doctor Livingston:

I appreciate the compliment of your kind invitation to present the technical features of the radical operation for cancer of the cervix uteri for the *American Journal of Surgery*. When this operation was our most effective means of combating this form of cancer, I gave much thought and work to the practical application of it to the cure of patients and to the helpful presentation of its technical details for the use of others. However, an advance has been made in the treatment of cancer of the cervix, which gives the patient a definitely better chance of cure than the most radical operation by the most experienced operators, and a far greater chance than operation as carried out by operators in general. Irradiation presents so much better chance of cure for these patients that it lays a serious responsibility on the leaders in this work (individuals and journals) to use their energy and talents to spread this information throughout the profession.

Feeling as I do, naturally I do not wish to further confuse the situation and push the radical operation by making a special presentation of it, with all the attractive illustrations and alluring details to which this operation so readily lends itself. In my *Operative Gynecology* I expect to retain a description of its principles and their application, because of its historical importance in the development of effective treatment for this disease. But as a method of choice in the handling of cancer of the cervix today, radical operation as opposed to irradiation is a back number—an obsolete method. However, it will probably take ten years yet for this knowledge to permeate the profession and bring to the patients generally the benefits of the most effective treatment, especially if journals and books push the operation.

Of course I appreciate that as an editor you wish to present all sides of the subject. This rather lengthy letter is simply a response to the courtesy of your kind invitation, giving the reasons for not being able to accept the same.

With best wishes in your difficult task,

H. S. Crossen.

I thought the letter would settle the matter as far as I was concerned, and that some one else would be commissioned to present the radical operation. But Dr. Livingston surprised me by patiently reading all the literature sent with the letter, and then countering with a statement that he had decided not to present the Wertheim operation and with a request that I submit an orienting editorial.

For detailed consideration of the various points reference must be made to published articles. Briefly, as elsewhere stated, present efficiency and future progress in the cure of cancer of the cervix are predicated on the following facts:

1. The successful care of a patient with cancer of the cervix is based upon an organized combination of expert services.

2. The crucial point of attack is not the uterus but the cancer cells along the pelvic wall. It is these outlying cells that must be reached and destroyed, or recurrence is certain.

3. Irradiation is the most important factor in attaining success in this concerted attack on the outlying cancer cells. There are exceptional conditions in which operative work with the knife also may be advisable, but whenever used operation should supplement irradiation and not displace it.

4. Too many of these patients are still being treated with halfway measures—with operations that never reach the outlying cancer cells, and with inefficient radium and x-ray treatments that carry no devitalization into the distant crucial zone.

That was a bold stand to take in those days, when controversy concerning this radical shift from operation to radiation was still raging, but time and experience have fully justified that stand, and it now constitutes the general rule of treatment in carcinoma of the cervix.

Radiation treatment is carried out by radium implanted in the uterus and deep x-ray therapy from the outside. Effective radium treatment, i.e., putting effective dosage into the area of outlying cancer cells, is based on the principle of extending the differential killing effect of radium (the cancer cells, being young, are more susceptible to radiation than the older normal tissue cells) by screening out the soft "burning" rays to permit heavy dosage of the deeply-penetrating hard gamma rays, as indicated in Fig. 802.

This is accomplished by means of metal screening and tissue screening and distance screening. The metal-covered radium is placed in the center of the cancerous cervix. The rectum and bladder are packed away by a firm vaginal packing of vaseline gauze, as shown in Figs. 803 to 805.

Deep x-ray radiation supplementing the heaviest safe dosage of radium, assists in reaching the outlying cancer cells with lethal dosage. Deep dosage is secured without damage to intervening tissues by employment of the principle of cross-fire, illustrated in Figs. 806 and 807. It is now usually applied through four to six fields—two in front lateral to the median line, two over the sacrum, and one over each hip when six fields are used. Fig. 808 shows the depth percentage distribution of radiation from a six-field application.

Occasionally the perineal field is used, principally in cases where the pelvic carcinoma has extended to the vaginal entrance. In addition to these external portals, intravaginal apparatus has been developed for giving deep x-ray therapy through the vaginal vault.

In the earlier days radium was almost our sole reliance in effective radiation of cervix cancer, but with advancing effectiveness of x-ray therapy it has become a decided help in this difficult task of devitalizing the outlying cancer

cells along the pelvic wall. Radium, however, is still our main reliance, though much is expected of future developments in deep x-ray therapy.

Of course continuous efforts to improve treatment results are being made in many directions, including implantation of radium directly into the outlying parametrium by long needles from the vaginal vault (Pitts and Waterman), direct x-ray treatment of the parametrium through the opened abdomen (Schumann), and operative removal of the lymphatic glands of the area (Taussig).
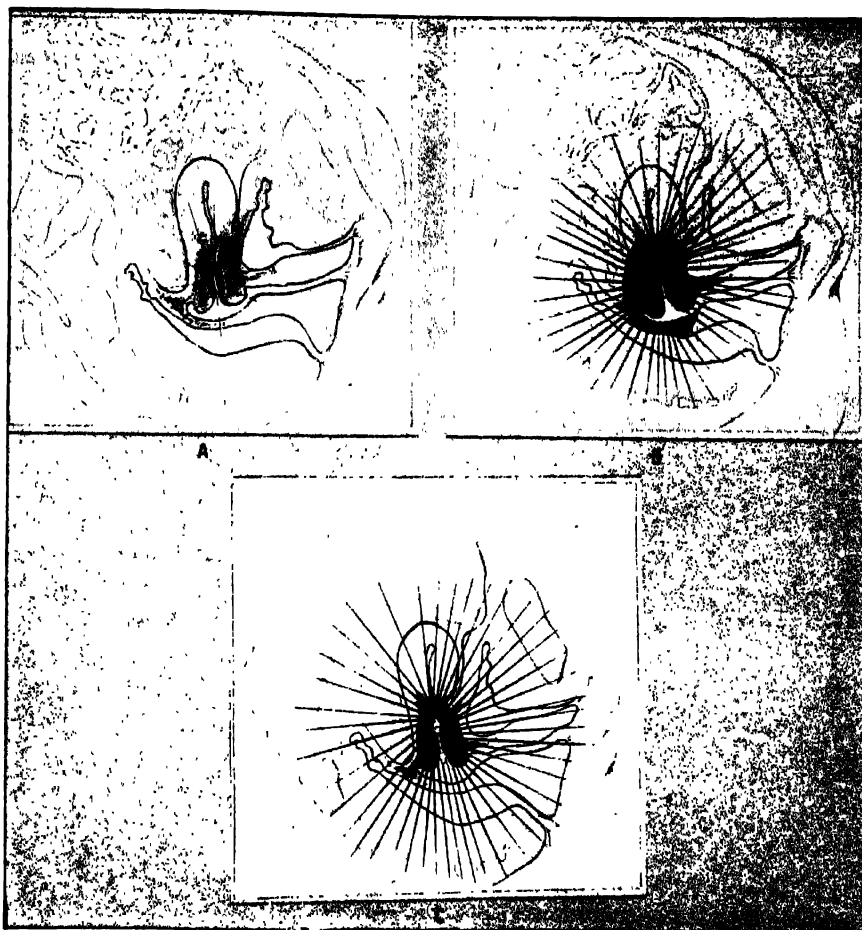
Fig. 802.—Metal and rubber screening. A. Indicating the effect of a small dose of unscreened radium simply in the glass capsule. The dark area represents the sloughing and the few radiating lines the small dose of deeply penetrating rays. B. Indicating the effect when the dose of unscreened radium is increased sufficiently to give an effective dose of the penetrating rays. The slough is extended into the bladder and rectum. C. Indicating the effect of the metal and rubber screening. The sloughing area is limited, so that a large dose of the penetrating rays may be given without sloughing into the bladder or rectum.

Those interested in these special measures will find articles in the Reference List. These and other special measures are used as supplementary to regular radiation treatment, which is the main reliance in cancer elimination.

The effective treatment of cancer of the cervix, whether accomplished with the knife or with radium, is a major surgical effort with the patient's life

hanging on successful execution of it. Hence it should be undertaken only by those with the required training and experience. The technical details are considered in the operative volume. The preparations and immediate after-care are about the same as for radium treatment of myoma, where are given also the details of removal of the radium. Later the treatment is symptomatic with the patient returning at regular intervals for pelvic check-up to see if there is any evidence of recurrent cancer activity and to direct further radiation treatment if needed.
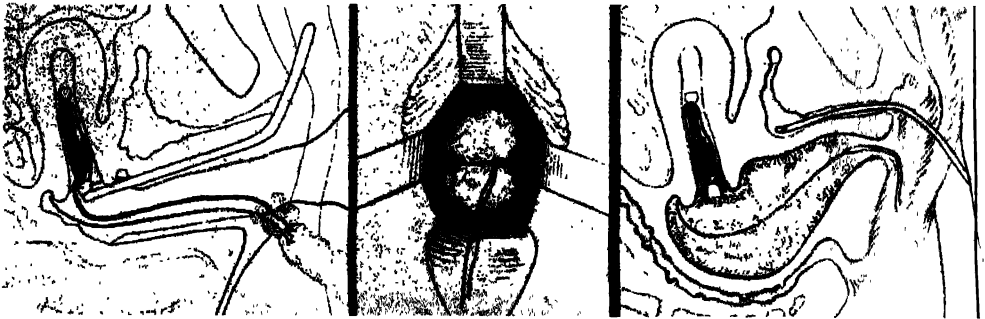
Fig. 803.   Fig. 804.   Fig. 805.

Fig. 803.—Anterior and posterior retractors in place ready to begin the firm vaginal packing with vaseline gauze, to push away the rectum and bladder as far as possible from the radium. This drawing shows also the long light-colored catgut suture passing through the cervix and rubber tubing (details of which are clearer in Fig. 753). It is well to tie the end of the packing to the radium string, as here shown.

Fig. 804.—The process of packing the vagina very firmly is facilitated by adding a ribbon retractor on each side, as here shown. The packing is in place, and the catgut tied over it.

Fig. 805.—Showing the firm packing in place, pushing away the rectum and bladder from the radium. Notice that the suture holding the radium package in position is tied over the gauze packing near the vaginal outlet, where it is easily reached for cutting and removal as explained in the text. The details of such removal have already been illustrated under radium treatment for myoma (Fig. 755). (Crossen and Crossen—*Operative Gynecology.*)
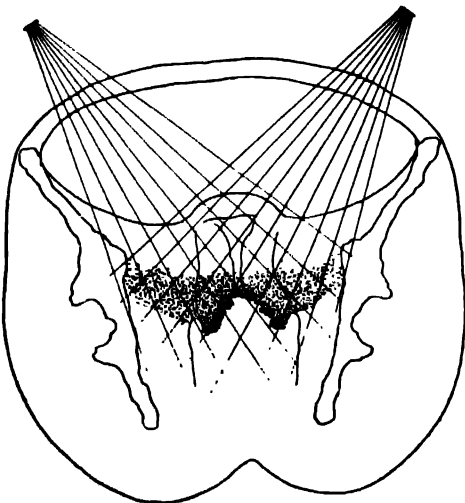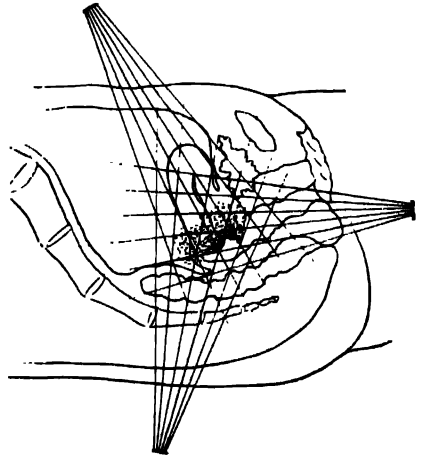
Fig. 806.   Fig. 807.

Figs. 806 and 807.—X-ray treatment of carcinoma of cervix uteri. In order to place sufficient dosage in the cancer area without injury to the overlying skin, extensive cross firing is necessary, and the use of many ports of entry, one after another. Fig. 806 indicates successive steps in firing through lateral portions of the abdomen. Fig. 807 indicates other ports of entry—the central abdomen, the sacral region, and the pelvic outlet. Improvements in technique have now made practical x-ray treatment through a vaginal speculum.

In the advanced cases the relief of pain is the important problem. Radiation is the most effective treatment. After it no longer helps and the milder sedatives fail, surgical measures including spinal injection and cordotomy are to be considered, for they may give much relief. Much was claimed for refrigeration treatment but the hopes have not been sustained. Vaughn, after a trial with several patients, concludes: "In my opinion this procedure is hazardous and is not justifiable in hopeless metastatic carcinoma."

When the advancing cancer causes a vesicovaginal or rectovaginal fistula, the problem of keeping the patient comfortable is greatly complicated. Much study has been given to meeting this problem, and help for the individual patient may be obtained by adaptation to her special needs of some one of the different types of apparatus devised, such, for example, as that shown in Figs. 537-539.

200 Kv X RAYS   FILTER 0 5 mm Cu   2 0 mm Al
T - S   DISTANCE   70 cm
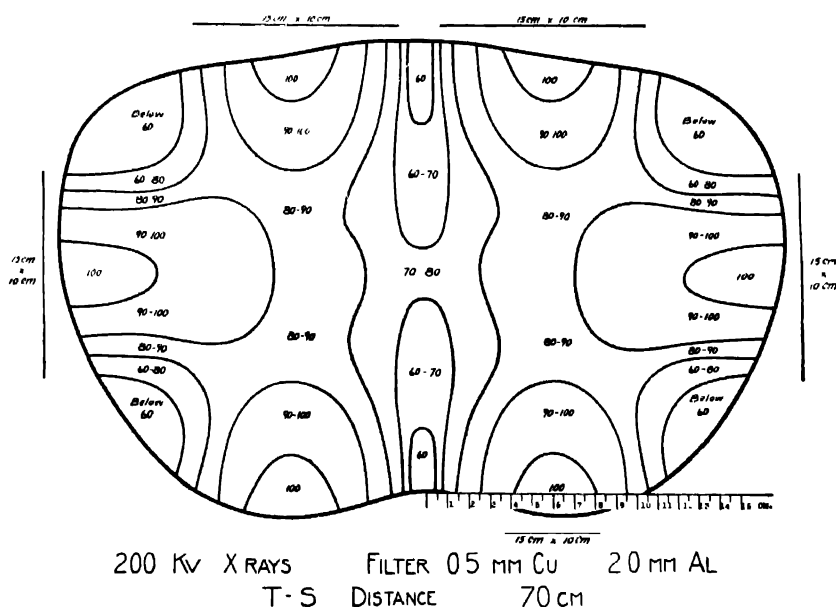
Fig. 808.—Distribution of roentgen radiation within the average female pelvis for the addition of lateral beams to two portals on both the anterior and posterior pelvic surfaces. (Arneson and Quimby—*Radiology*.)

PREGNANCY

WITH CERVIX CANCER

The guiding principle in the treatment of this condition is to treat the carcinoma. There are, of course, not only varying ages of pregnancy to be considered, but also varying stages of carcinomatous extension. Any combination of these two may be present in any given case, so a consideration of both factors guides one in determining the best treatment for the particular case.

Cases in early pregnancy with an early or late lesion should have adequate radiation immediately. This would of course kill the embryo and in most cases cause an abortion. If the uterus does not empty after six to eight weeks, it is emptied operatively by curettage.

When the pregnancy is between four and seven months the treatment depends upon the mother's desire for a living child and the stage of the preg-

nancy. With an early lesion in a pregnancy just short of viability in a mother very desirous of offspring, 3,000 mg.hr. of properly screened radium should be given. There should be a distance of at least five centimeters between the radium and the head of the fetus. External version and Trendelenburg position during radiation are advisable for protection of the child. This plan does not harm the fetus at this stage and may hold the carcinoma in check long enough to permit the delivery of a viable fetus. As soon as the child's chance of surviving is fairly good, a Porro cesarean section is done to rescue the fetus. Following this, radiation should be given as for any like case of carcinoma.

When the mother has children and the urgent indication is to save her to take care of them, adequate radium and x-ray radiation should be given at the outset. This causes the death of the fetus, and delivery is completed later, either from below or by cesarean section or Porro section as seems best in the particular case.

In pregnancy between seven months and full term in which there is an early lesion of the cervix, the treatment of choice is a cesarean section (Porro) followed by adequate radiation. When the lesion is more advanced moderate radiation is given first, followed by Porro section and then adequate radiation. This plan helps to reduce the operative risk by reducing the accompanying infection and by causing some regression of the carcinoma.

In the last group of cases, those at term, the management depends upon the condition of the cervix, presentation of the fetus, and extent of the carcinomatous process. As a general rule, delivery through a carcinomatous-riddled cervix is contraindicated. The dangers are hemorrhage from deep tears, sepsis, and spread of the carcinoma cells. In very early lesions, with the head low and a dilated cervix, delivery from below may be indicated. Unless conditions are favorable for delivery from below, or if the carcinoma is beyond the early stage, a Porro section followed by adequate radiation gives the patient the best chance to survive.

Baer's article is helpful, particularly in its classification of cases and treatment advice for various classes. Emge reviews extensively the effects of pregnancy on tumor growth, concerning which there is considerable difference of opinion among investigators. Chalfant and Mering give the details of the handling of a case with instructive comments.

Prevention

The subject of prevention of cervix cancer was discussed in detail by the senior author ("Prevention of Cancer of the Cervix Uteri," Am. J. Obst. & Gynec.) and the following summary is from that article.

The growing appreciation of the importance of the fact that we are not getting these cancers early in spite of all efforts to do so, has resulted in a careful and anxious re-examination of the whole situation as it relates to cancer of the cervix. There is much discussion of what constitutes the earliest cancer changes, and how they may be recognized in the microscopic examination of excised tissue. New methods of clinical recognition, such as ocular magnification in the vagina with the colposcope and chemical reaction with Schiller's iodine painting, are being tested for discerning beginning cancer changes in the epithelium of the cervix. All these steps for detecting the earliest cancer changes are

important and are to be encouraged. But far more radical measures than these are necessary to produce any marked advance in the prevention of deaths from this disease. It is necessary to attack this serious problem in some other way than by explaining cancer signs and symptoms to physicians and patients. *We must go back of the whole cancer picture, and remove the conditions which precede the cancer and cause it.*

It is well established that cancer development in this location is favored by long-continued irritation in the form of chronic cervicitis, usually accompanied with laceration, eversion, infiltration, and cystic change. As we have said many times, these lesions are very obvious and their rôle in cancer origin is generally known, and yet they are allowed to go on and on well into the cancer age. Great pains are taken in cases of chronic cervicitis to detect the first signs of cancer so that treatment for cancer may be promptly instituted, whereas a far safer plan is to remove the chronic cervicitis promptly before it becomes cancer.

Chronic cervicitis may be cured by simple excision of the affected area of the cervix, and thus cancer prevented. But when cancer has once begun in the irritated area, cure is uncertain even by the most radical measures.

It is clear then that an important step in preventing deaths from cancer of the cervix is the systematic and early removal of those chronic irritative lesions of the cervix which precede cancer. Not only is this an important step, but it seems the only step by which to secure further marked reduction in deaths from this disease.

The importance of removing chronic irritative lesions in the cervix has long been recognized and emphasized by leaders in gynecology. Our hope is to supplement these sporadic warnings with a systematized plan of action which will deal effectively with this serious situation.

GENERAL PLAN OF ACTION

In formulating a systematized plan of action, the following three facts must be taken into consideration:

1. Thousands of patients are receiving palliative treatment for chronic irritative lesions in the cervix, such as cervicitis, "ulceration" of cervix, laceration, eversion, erosion, and polyps. The palliative measures keep the patients fairly comfortable, but they do not remove the deep chronic irritation which favors the development of cancer.

2. Other thousands of women are treating themselves for "a little leucorrhea" in ways that may keep them comfortable but do not stop the process of cancer development in the irritated cervix.

3. There are other women in whom the chronic irritation in the cervix does not give rise to any symptoms that would cause them to suspect local trouble.

In the attempt to eliminate these chronic irritative lesions, which eventuate in a large number of deaths from cancer of the cervix, means must be found for reaching the above-mentioned three classes of persons. Effective work in this direction requires energetic action along two important lines as follows:

A. Work by individual physicians with their patients, to the end that chronic irritation in the cervix be removed before it eventuates in cancer.

B. Extension of present excellent educational work to include measures for making clear to the public the fact that cancer of the cervix develops without any warning signal, hence the importance of local examination, that any existing irritation of the cervix may be eliminated before cancer develops.

The above twofold plan takes care of the problem theoretically, but we cannot be satisfied with theory and principles only. This is such a serious matter that details must be carefully worked out and tested and every possible means devised and activity employed to secure results. The issue of life or death is being decided daily for many—even members of our own family may be crossing the line between inflammation and cancer. The working out of the principles of a plan is only a part, and the smaller part, of the solution of this great problem. Each of the two large divisions in the twofold plan mentioned has subdivisions which require careful and extended consideration in order to secure practical action and the attainment of definite results. We are concerned here principally with the work of the individual physician with his patients.

WORK OF PHYSICIAN WITH HIS PATIENTS

The physician is the leader and mainstay in this serious campaign. Each physician has it in his power to aid materially in the general reduction of deaths from cancer of the cervix and in saving his individual patients from this fatal disease. This is a wonderful opportunity for important constructive work by every physician. Cancer is such an extensive subject, with such deep and abstruse problems baffling the talent and facilities of great institutions, that we are inclined to think that important work in connection with it must be entirely the privilege of those with special training and special facilities. But here is an opportunity for every physician to give definite aid in the great fight which is going on all over the world to lessen the number of deaths from cancer of the uterus. No matter where the physician is located nor how limited his facilities, he has it in his power to take an important part in this great work. The details of effective work by the physician in this direction include the following:

1. In the handling of patients with inflammation or irritation of the cervix, chronic irritation must not be allowed to persist. This applies especially to patients past thirty-five, though cancer occurs also before that age. Having eliminated acute irritation by douches and local treatment, any remaining chronic irritation should be removed by conization or other radical measure. I do not care at this time to take up the pros and cons regarding the different methods of treating these minor lesions of the cervix; suffice it to say that the treatment should eliminate the chronic irritative lesion. Temporizing palliative treatments do not remove the danger.

It is important to remember that a certain proportion of cancers of the cervix (in some series as high as 10 per cent) occur before the age of thirty-five. This means that the old idea of postponing repair of the cervix to the end of the childbearing period is not safe. We know that chronic irritation in the cervix may result in cancer in younger women. Several cases in patients under the age of thirty have been reported. Consequently it is dangerous to allow irritation in the cervix to persist even in the childbearing period.

The only safe plan is to eliminate the area of chronic irritation. Carried out circumspectly with care to avoid undue sacrifice of normal tissue and unnecessary scar formation, it should aid rather than interfere with subsequent childbearing. Even though there should be some laceration with a subsequent labor, repair of this is a minor matter compared to risking cancer development.

2. Patients in whom cervical irritation has cleared under treatment, should be watched by occasional check-up examination to see if the irritation returns.

3. Patients who come for other conditions, should be asked about leucorrhea and other evidence of pelvic disturbance, that the required examination and treatment may be carried out.

4. Patients who come for other conditions and have no pelvic symptoms, present one of the difficult problems in this cancer prevention. We know that even without subjective symptoms there may be sufficient chronic irritation in the cervix to favor aberrant cell activity resulting in cancer. On the other hand, a practicable rule of action must take into consideration the patient's natural reluctance to examination not indicated by symptoms.

Here is where the leadership of the physician comes in. By tactful instruction, that causes no undue apprehension, the patient may be made to realize the advisability of a local examination as part of the general examination on which his responsible advice to her is to be based. The age at which such local examination is required in patients without pelvic symptoms will vary somewhat with the history and circumstances, but in general it is advisable by age thirty-five or earlier.

From the physician's standpoint, this local investigation as part of the general examination is imperative. His responsibility as the patient's medical adviser makes it necessary for him to know definitely whether or not there is beginning cancer of the cervix or chronic irritation there that may lead to cancer. The internist, the general practitioner—every physician who assumes the responsibility of advising a patient in regard to her general health —must keep in mind the possibility of symptomless chronic irritation in the cervix that may eventuate in cancer.

5. How often should the local examination be repeated? The patient will sometimes ask this question. And the physician should have decided it for himself in preparation for advising the patient, whether or not she asks it.

It is important to work out a practicable plan. The local examination should be made often enough reasonably to exclude irritation that would favor cancer development. At the same time the interval should be as long as is safe, in order to avoid unnecessary trouble and expense to the patient. Also, the choice of interval should be such as to appear reasonable to most patients when the matter is explained to them. The choice of a rather long interval which appears to the patient so reasonable that she returns regularly, will go much farther toward preventing cancer than the choice of an interval so short that the patient neglects it and finally gives up regular examinations. Considering the various angles of the matter, it seems to me that a reexamination once a year from age thirty-five to fifty-five, is a reasonable rule to incorporate in our advice to these patients.

The probability of the patient's cooperation in the idea of a regular yearly examination may be enhanced by pointing out that this twenty-year period is one of change in body structure and function, and that many authorities are recommending yearly general examination as a safety measure to determine how the various vital organs are standing the wear and tear of life's activities. This reenforces and emphasizes the idea of regular general examinations, of which the local examination is a part.

In the years before thirty-five and after fifty-five, occasional examinations are desirable, but for the present it seems best to concentrate on the twenty years mentioned, and to use our energy and educational facilities to drive home the importance of regular yearly examinations during that crucial period.

Public Dissemination of Information

It is necessary to give the public reliable information on this subject for two reasons: first, to supply to those persons who do not consult a physician the information they would not otherwise obtain and, second, to emphasize to patients the importance of following the advice on this subject given by their physicians.

An important part of the instruction of the public in this matter will come indirectly from the individual physician, through the general contacts and conversation of his patients to whom he has given advice.

The other important means of public instruction include the local and state and national medical societies and those special organizations of mixed professional and lay membership which have been so helpful in disseminating reliable information on health matters. The American Society for the Control of Cancer has done splendid work in educating the public to an appreciation of cancer symptoms and the importance of seeking prompt relief. To it naturally falls the leadership in this additional step for preventing deaths from cancer, namely, instruction of the public as to the necessity of regular periodic examinations for the discovery and removal of chronic irritative lesions which precede cancer. Considerable work has already been done along this line, but much more remains to be done in regard to cancer of the cervix.

In this campaign of cancer prevention and early detection the nullipara and the virgin must not be overlooked as victims of insidious cancer development. Cancer of the corpus uteri in considerable proportion of the cases is found in nulliparae, particularly in those with uterine fibroids. Even cervix cancer occurs in the nullipara and the virgin. Lash calls attention to the fact that Mattmuller found 9.7 per cent of nulliparae among 442 patients with cancer of the cervix and several of these were virgins. He reports a case of his own. In this patient, aged forty years, with uterine myoma, the intact hymen was so tight that examination had to be made by rectoabdominal palpation. The cervix was closed and smooth, corpus enlarged to size of a twelve weeks' pregnancy and hard and free, and adnexa presented no palpable lesion. The

myomatous uterus was removed and there was found, in addition, a carcinoma of the cervical canal (adenocarcinoma). Macfarlane, Fetterman and Sturgis conducted an experiment in cancer control and presented an instructive report on the periodic pelvic examinations in one thousand well women.

As previously mentioned under Chronic Cervicitis, the cancer-preventing results already definitely attained by effective treatment of chronic cervicitis are encouraging. Craig found that in 2,895 cases of cervicitis treated adequately and then followed for a period of ten years or more not one patient developed cervix cancer. Camperman estimated that cancer of the uterus is found in 4 per cent of gynecologic patients, and Frankl found that 89 per cent of uterine cancers are in the cervix. Accordingly, in this one series of 2,895 patients, cancer of the cervix was prevented in 112 women.

CARCINOMA OF CORPUS UTERI

Carcinoma of the corpus uteri constitutes a distinct class, having better prognosis than carcinoma of the cervix. It begins in the endometrium; consequently the tumor tissue is accessible to the curette at a very early stage. The growth is for a long time confined to the tissues immediately about the uterine cavity, the extension to the periuterine tissue being slow—hence the chance of cure is much better. Carcinoma of the corpus comprises 10 to 15 per cent of all uterine cancers.

Etiology

In regard to age, the decade for most frequent occurrence of corpus cancer is from fifty to sixty years, thus differing from cervix cancer which occurs most frequently in the decade forty to fifty years. Koblanck found 50 per cent of corpus carcinoma in the decade fifty to sixty years. In our series of 56 cases with five-year results, the age incidence by decades was: ages thirty to forty, 4 cases; forty to fifty, 15 cases; fifty to sixty, 21 cases; sixty to seventy, 13 cases; seventy to eighty, 2 cases, and eighty to ninety, 1 case.

In regard to pregnancy, Wilson concludes it has no etiologic importance, as an equal percentage occurred in the parous and in the nulliparous. In our series only 38 per cent were nulliparous.

As an etiologic factor in corpus carcinoma prolonged endometrial activity seems to be of definite importance. The relationship of undue endometrial activity at the critical age of declining function to the onset of endometrial carcinoma is an important subject, and one not yet clarified. Most gynecologists have a general feeling that late continuation of menstruation, into the period when the endometrium should be inactive, indicates a tendency to erratic epithelial activity and hence to cancer. However, the various points need to be investigated and the facts, pro and con, established by conclusive evidence. One of us (R. J. C.) has been working on this problem for some time, and in a preliminary report of an analysis of our own cases (J. Missouri M. A.) reached the following conclusions:

The occurrence of hyperplasia of the endometrium is an indication of excess estrogenic influence. Whether or not this excess estrin tends to induce

malignant development is a point still to be determined, though there is some evidence that it so operates at times in the breast and also in the uterus. It seems hardly probable that the normal stimulus to activity, on which the healthy functioning of the organ depends, would induce cancer which is an unhealthy functioning. The real cause is probably some abnormal condition of cell nutrition or environment (irritation), and the excess estrin may be only an index of nature's attempt to overcome the systemic or local abnormality.

While endometrial hyperplasia with its associated excess estrin may not be of importance in the childbearing period, when great activity of the endometrium is normal, our study and experience previously mentioned indicate that endometrial hyperplasia found in late menopause is of sinister significance, and should lead to radiation or other treatment for stopping such activity.

Fig. 809.   Fig. 810.   Fig. 811.
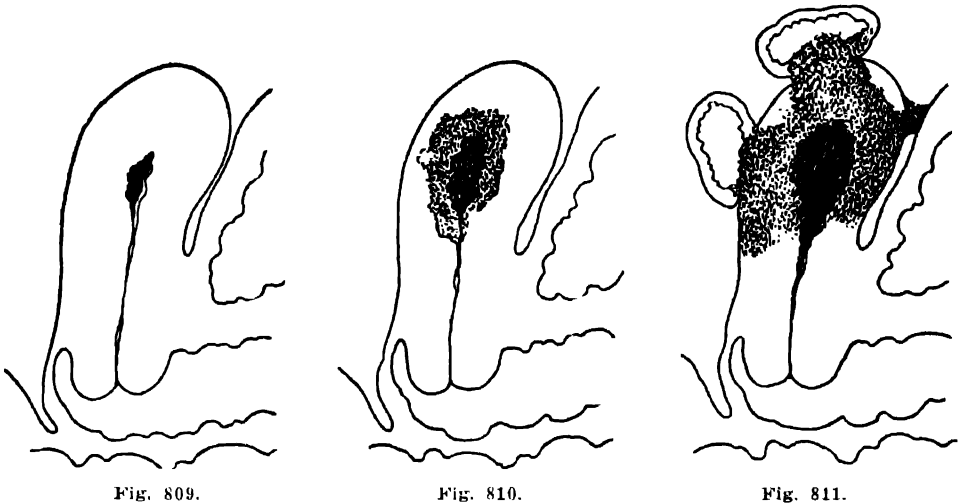
Figs. 809 to 811.—Progressive development of carcinoma of the corpus uteri. Fig. 809, Carcinoma of the corpus begins in the endometrium. Fig. 810, Extensive involvement of the uterine wall. Fig. 811, Extension through the uterine wall and involvement of adjacent structures.

Pathology

Gross.—In carcinoma of the corpus (endometrial carcinoma), the uterus may or may not be larger than normal. As this cancer occurs most frequently between the ages of fifty and sixty years, the uterus, in the early stage of the carcinoma, may be senile and considerably smaller than a normal adult uterus. As the disease advances the uterus enlarges progressively and as the process penetrates the wall, adjacent structures become involved. This progressive involvement is indicated in Figs. 809 to 811. Gross specimens of the disease in different steps of development are shown in Figs. 812 to 814.

Microscopic.—The microscopic characteristics of carcinoma of the endometrium are shown in Figs. 815 to 819. Endometrial carcinomas are graded into four classes, representing graduations in structure from the mature glandular form of mild malignancy to the immature solid form of great malignancy. This grading was suggested by Mahle, on the basis of MacCarty's standard of cell differentiation. Healy has done much helpful work in clinical
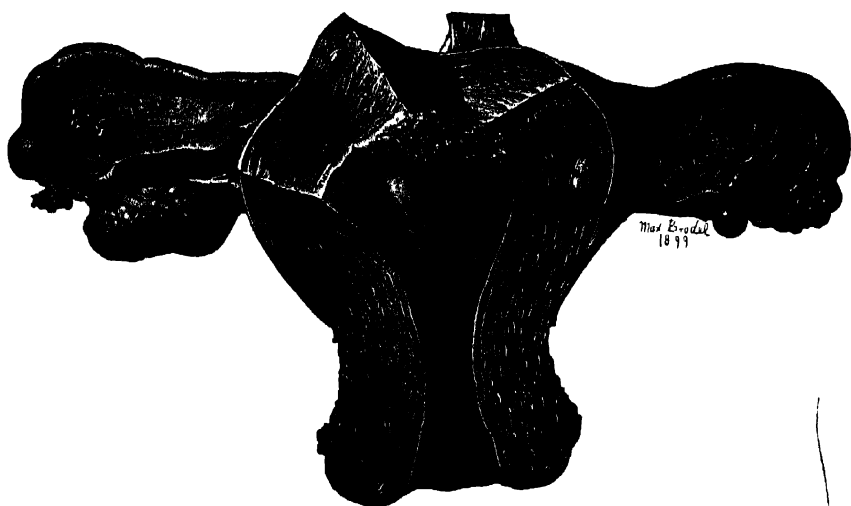
Fig. 812.—Beginning carcinoma of the corpus uteri. There is no external sign of the growth at this stage, except an occasional streak of blood in the leucorrheal discharge. The diagnosis must be made by curettage. (Cullen—*Cancer of the Uterus*)

Fig. 813.   Fig. 814.

Fig. 813.—Drawing from a specimen of a comparatively early carcinoma of the corpus uteri. Gyn. Lab.

Fig. 814.—Drawing from a specimen of a more advanced carcinoma of the corpus. The growth has invaded the muscular wall extensively, but the peritoneal covering of the uterus is not yet involved. Gyn. Lab.

application of the grading and in developing its general use, and his name is frequently attached to this grading system, though in his writings he gives full credit to Mahle.

In connection with the fact that this grading is based on the extent of departure from normal gland forms, it may be noted that endometrial hyperplasia represents a type of endometrial structure lying between normal endometrium and carcinoma of Grade I. In fact, the diagnosis in a doubtful case

Fig. 815.

Fig. 816.

Figs. 815 and 816.—Diagnostic curettings, under low power and high power Gyn. Lab.

Fig. 817.—Adenocarcinoma of the corpus uteri. This is a section of the entire thickness of the wall of the removed uterus. The endometrium (left end) had been largely removed by a diagnostic curettage a few days before the hysterectomy. The diagnostic curetting is shown in Fig. 816. Gyn. Lab.

consists usually in determining whether the condition is hyperplasia or beginning cancer. Consequently the characteristics of hyperplasia are shown (Figs. 820 and 821) along with those of carcinoma, Grade I.

An interesting fact in connection with the slides showing hyperplasia and those showing carcinoma of Grade I is that they are from the same patient. One year after she was curetted and the hyperplasia found, symptoms returned requiring another curettage and the carcinoma of Grade I was found.

The points cited in the following differentiation into grades are largely from Healy's clear description (Healy and Cutter, Am. J. Obst. and Gynec.).

Grade I (Figs. 822 and 823). Papillary Adenoma Malignum. This is a characteristic form in which the growth is superficial and entirely papillary. The papillae are low, the cells are not very atypical, and there is no infiltration. As the cells are not multiplying rapidly, the glands are well formed. Some cases are extremely difficult to distinguish from adenomatoid endometritis. It is in this histologic type that cures following curettage have been observed.

Grade II (Figs. 824 and 825). Adenoma Malignum. This group comprises those cases in which the uterine glands are markedly enlarged and elongated. They are often thrown into folds and convolutions to form inside papillae. The cells are cuboidal or cylindrical and are arranged in compact layers about the gland lumen. The nuclei are very hyperchromatic, giving to the stained section a dark appearance. Mitoses are often abundant. The entire tumor appears to be composed of giant glands encroaching upon the interglandu-
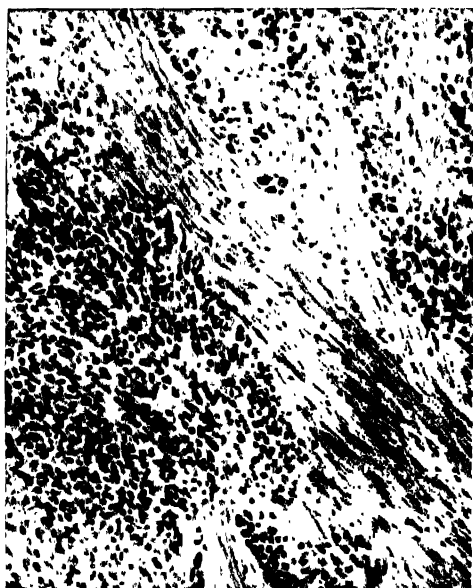
Fig. 818.

Fig. 819.

Fig. 818.—Same growth as in Fig. 817. This is at the spreading edge of the growth and shows the carcinoma cells penetrating the muscle tissue. Gyn. Lab.
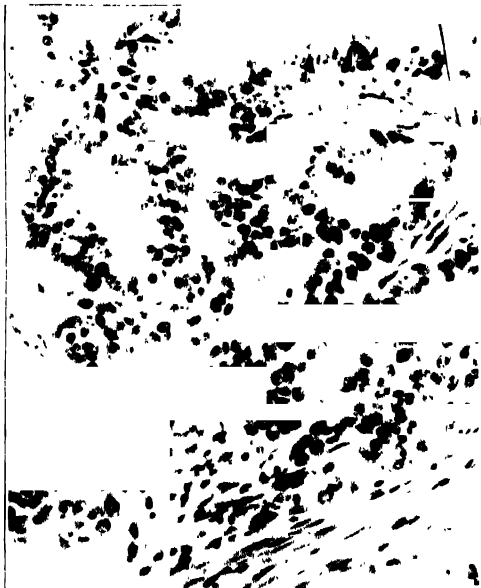
Fig. 819.—Same growth as in Fig. 817, higher power. This is in a portion of the growth where the adenomatous arrangement of the cancer cells is well marked. Gyn. Lab.

lar connective tissue. The stroma is thus scant and adjacent glands come in direct contact. The polarity of the tissues is everywhere maintained. As Lindsay has emphasized, if at any point the cells show a tendency to form solid masses and infiltrate the stroma, the tumor should be classed as adenocarcinoma.

Grade III (Figs. 826 and 827). Adenocarcinoma. Adenocarcinoma includes all cases in which the tumor forms solid masses of cells which grow in cords and columns. There is definite loss of polarity with infiltration of the stroma. Signs of anaplasia are more marked than in adenoma malignum. The cells are more atypical. Not infrequently portions of the tumor show adenoma malignum and other parts adenocarcinoma. These tumors are classed as adenocarcinoma. Although the growth is more atypical than in adenoma malignum, the glandular arrangement is still maintained.

Grade IV (Figs. 828 and 829). Diffuse (Embryonal Anaplastic) Carcinoma. This group is characterized by a complete loss of polarity. The glandular arrangement is entirely lost. The growth is diffuse and is composed of small round and polyhedral cells,

Fig. 820.--Endometrial hyperplasia, for comparison with endometrial carcinoma, Grade I. Gyn. Lab.
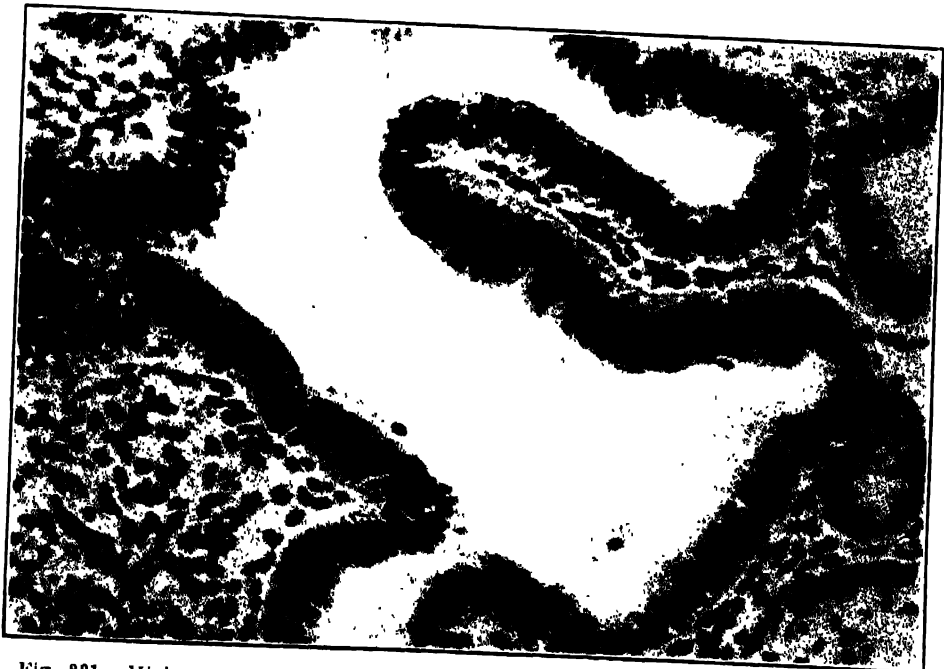
Fig. 821.--Higher power of the endometrial hyperplasia shown in Fig. 820. Gyn. Lab.
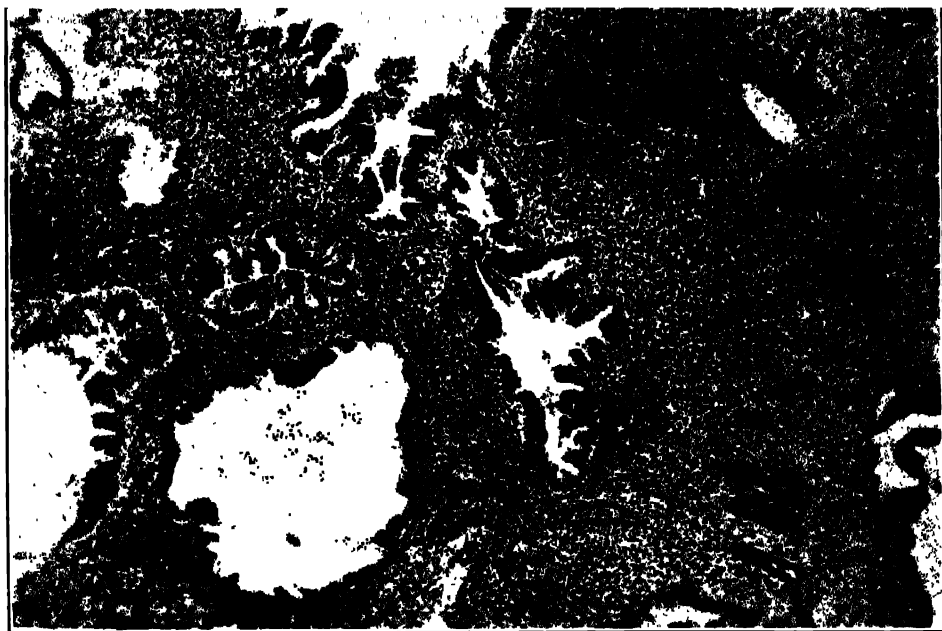
Fig. 822.—Endometrial carcinoma, Grade I. Note the well-developed glandular character and resemblance to hyperplasia, except for the abnormal piling-up of the epithelium and the character of the cells. Gyn. Lab.
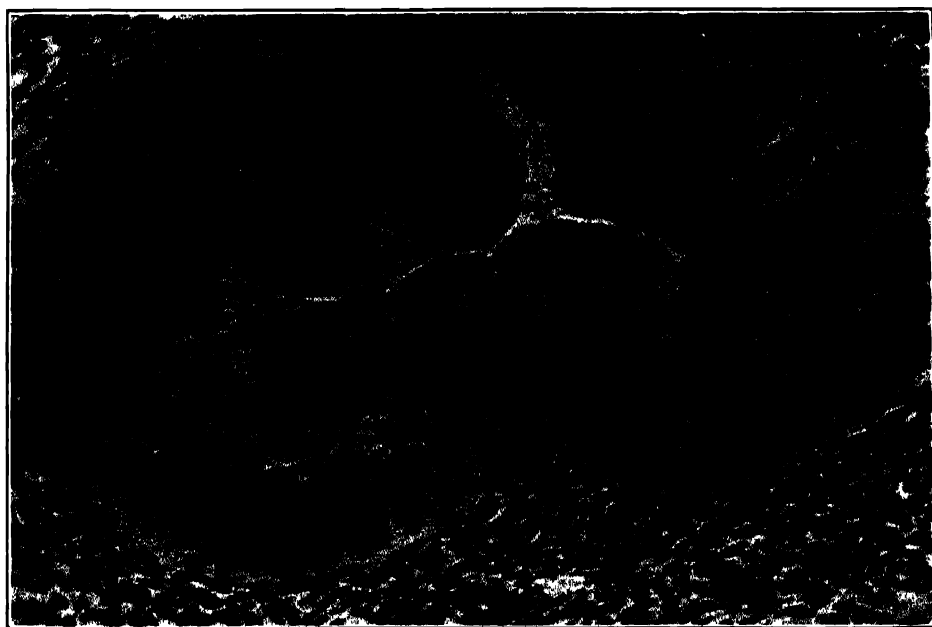
Fig. 823.—Higher power of Fig. 822, showing details of the cells and their arrangement. Gyn. Lab.

Fig. 824 — Endometrial carcinoma, Grade II. Notice the increasing departure from normal gland characteristics, as explained in the text. Gyn. Lab

Fig. 825.— Higher power of Fig. 824, showing details of the erratic cell activity. Gyn. Lab.

Fig. 826.—Endometrial carcinoma, Grade III. Shows the increasing tendency to solid invasion, but there are still irregular gland patterns. Gyn. Lab
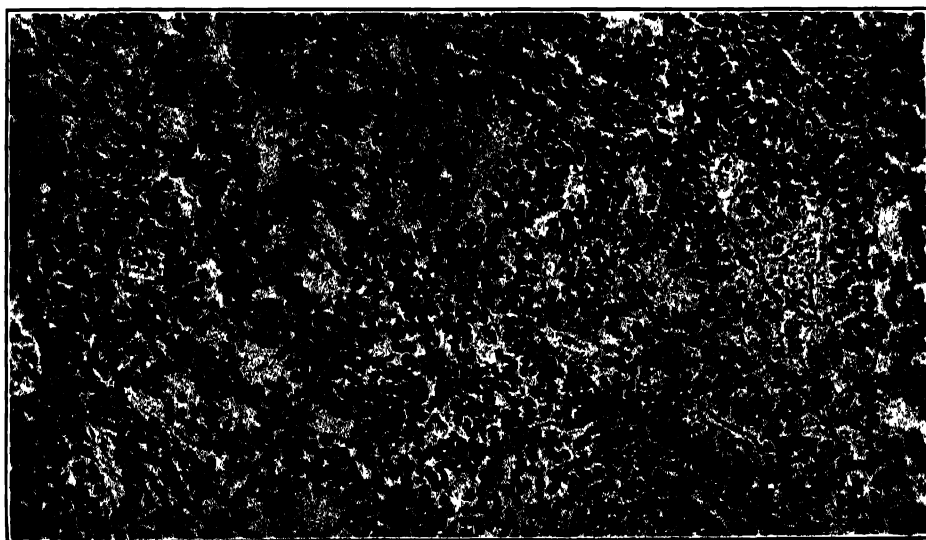
Fig. 827.—High power of Fig. 826. Gyn. Lab.
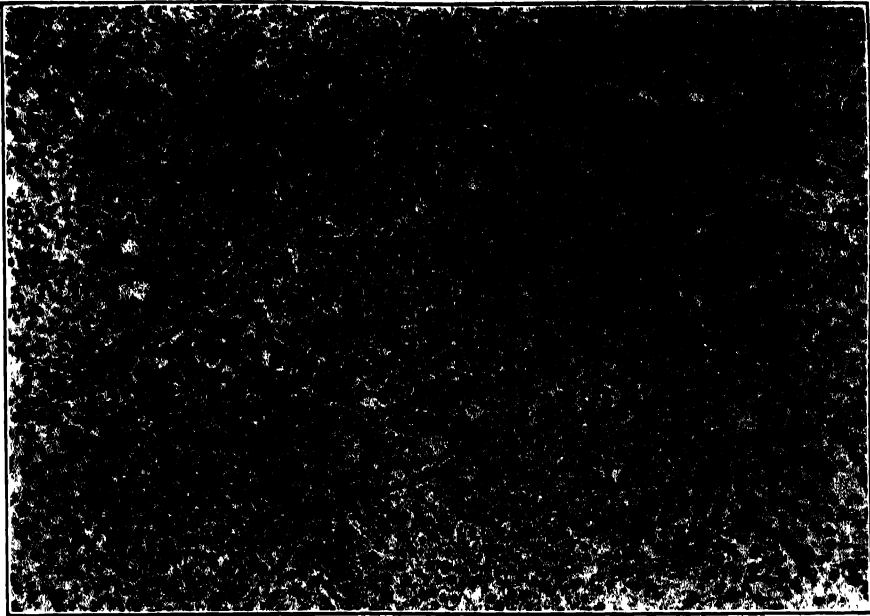
Fig. 828.—Endometrial carcinoma, Grade IV. The malignant cell change has advanced to the point of solid invasion, with only an occasional suggestion of gland tendency. Gyn. Lab.
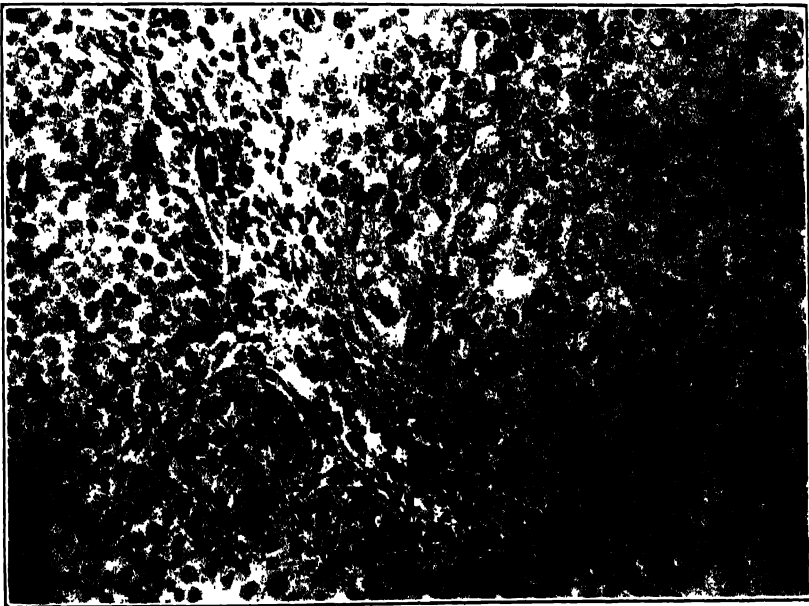
Fig. 829.—High power of Fig. 828, showing character of the cells.

closely packed, growing in sheets and cords. The nuclei are small and hyperchromatic and the cytoplasm is scanty. There are marked signs of anaplasia. There is complete loss of differentiation. Mitoses are very abundant. The histologic structure often closely resembles anaplastic epidermoid carcinoma of the cervix from which it may be difficult to distinguish microscopically. Fig. 830 shows mixed grades in carcinoma of the endometrium, Grades I and IV.

Fig. 830.—Adenocarcinoma of the endometrium, showing different grades in the same specimen Grade I left and Grade IV right.
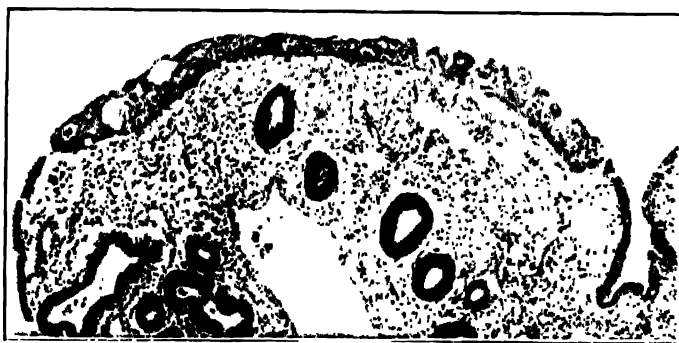
Fig. 831.—Squamous "metaplasia" or "epidermization" of the surface epithelium in a case of hyperplasia of the endometrium and adenomyoma. This is a purely benign change. (Novak—*Am. J. Obst. and Gynec.*)

The malignancy of these grades increases from group one to group four, and the response to radiation is in the reverse order.

Epidermization, described and illustrated in connection with the diagnostic problems of cervix cancer, occurs also in the endometrium. It is not frequent in this situation, and is probably due, as a rule, to metaplasia (Ruge) or to "rests" of embryonal cells which retain the power to develop into the squamous type (Meyer).

Fluhmann states that he found only six cases in the literature, including his own. Novak states that it is probably not so rare. Hintze reported nine cases.

Novak feels that the condition is essentially benign and states that seven of Hintze's patients were cured by simple curettage, and have remained well

from two to five years after operation. Fig. 831 shows surface epidermization of the endometrium overlying an adenomyoma, and Fig. 832 shows the epidermization in the deeper glands. Fig. 833 shows metaplasia in an adenocarcinoma.

Metastases.—The adenocarcinomas of the corpus are relatively slow growing as cancer goes, and they metastasize late from Grades 1 and II. Grades III and IV grow more rapidly, and the prognosis is much more grave.
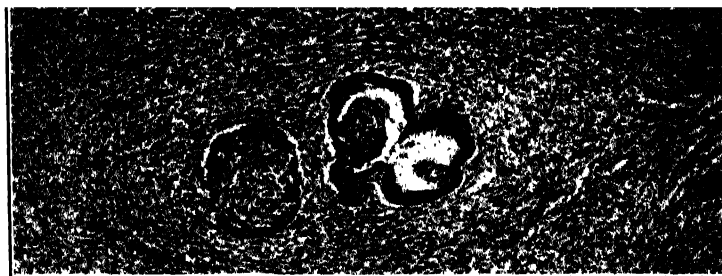
Fig. 832.—"Epidermization" of deeper lying gland epithelium of adenomyoma in same case. These changes, formerly considered as evidence of malignancy, are now looked upon as definitely benign (see text). (Novak—*Am J. Obst. and Gynec.*)

Fig. 833.—Extensive squamous metaplasia in an adenocarcinoma of the uterus Here there is no doubt of the transition from a primary gland carcinoma, but in other areas the squamous change is so extensive that the primary character of the tumor is blotted out. Such cases have in the past often been wrongly interpreted as combinations of squamous cell and adenocarcinoma. (Novak—*Am. J. Obst. and Gynec.*)

Symptoms and Diagnosis

Carcinoma of the corpus starts in the endometrium, and hence gives rise early to excessive menstrual flow or spotting between periods. On this account the patient is likely to seek medical advice early in the disease, and if the physician recognizes the warning signal and acts accordingly a fairly early diagnosis results. The diagnosis depends on microscopic examination of curettings. Hence the importance of employing curettage when there is a bleeding tendency which does not yield promptly to medication, particularly if the patient is past thirty-five years of age. Very often in these bleeding cases there is also chronic cervicitis, which is an additional reason for urging the curettage, as the chronic cervicitis may be taken care of at the same time by conization. The curettage is effective treatment for the endometrial bleeding, and the conization removes the menace of chronic irritation

in the cervix. All tissue removed is subjected to microscopic investigation which gives definite information as to what process is going on in both cervix and corpus and whether or not there is any complicating malignancy. A point of importance is that the curetting should embrace all parts of the endometrial cavity, and then *all* curettings should be preserved and subjected to microscopic examination.

Uteroscopy with special endoscopic tubes has been used in these cases, as has also x-ray visualization of the endometrial irregularities by injecting opaque material. These measures combined with special instruments for clipping off specimens of such irregularities for cancer diagnosis, may have a strong visual and technical appeal to the uninitiated—so strong as possibly to obscure other important features of the situation. Hence it may be well to call attention to certain points in this connection. This method is *contraindicated* on account of the *danger* and also on account of the *inaccuracy* or inadequate handling of the diagnostic problem. The danger of the injected fluid carrying carcinoma cells into the peritoneal cavity has been mentioned. Sampson has demonstrated the transfer of cells from the endometrium through the tubes from slighter causes than injection, and in carcinoma such transportation by injected fluid might have serious results.

In regard to inaccuracy, this method seems to be a reversion to the old unsatisfactory plan employed in suspicious cervix cases, namely, excision of a small specimen and if no cancer is found then waiting and perhaps another specimen excision later as conditions develop. This has now been superseded by a more adequate method which consists of excision of the whole involved area. Thus all the involved tissue is secured for microscopic investigation, so that negative findings really exclude cancer, and at the same time there is effective treatment for the nonmalignant lesion which stops the chronic irritation. Fortunately, in corpus cancer gynecologists started with the thorough method of removing the whole diseased endometrium by curettage and submitting it all to microscopic examination. To do less would seem a backward step in diagnosis. Again, a bleeding uterus needs treatment as well as investigation, and removal of the diseased endometrium by curettage furnishes this.

Clinical Classification.—An item of diagnostic importance is the extent of the disease. While pathologic grading of carcinoma of the corpus according to cell type and arrangement is now on a firm basis and proving useful, clinical classification on a practical basis has been delayed. A dependable clinical classification of cases of carcinoma of the corpus into stages of progress is a complicated matter, much more complicated than appears on the surface. It has been delayed by difficulties not found in carcinoma of the cervix. In cervix cancer the location and extent of the marked infiltration can be determined by palpation, and the depth of the vaginal and cervical ulcerations are open to easy and accurate inspection. Not so in corpus cancer, where the various stages of extension into the thick uterine wall defy palpation and inspection, and can be outlined only after the uterus is removed.

Despite the difficulties, however, the attempt to work out a satisfactory clinical classification of these cases should be persisted in and vigorously pushed. The reliable and uniform grouping of these cases into clinical stages representing extent of growth is absolutely necessary for the evaluation of treatment results. In comparing the results of different methods of treatment, the comparison must be made between cases of the same approximate extent of involvement, i.e., early cases to early cases, medium advanced to medium advanced, and late cases to late cases. Otherwise there may be erroneous conclusions as to the efficacy of the different treatment methods.

Such classification requires careful examination and accurate recording of findings before operation, of gross findings at operation, and then of gross findings in the laboratory. This division into stages representing extent of growth must of course be founded on a solid *pathologic* basis. That is, the clinical stages cannot be defined by symptoms but must represent definite extent of growth as determined by examination at operation and in the laboratory. Hence, the stages of the classification to be made before operation as a guide to treatment must be defined in terms of pathologic extent which can be accurately determined only after operation. This paradox shows very well the vicious circle of difficulties encountered, and the reason why the solution of this important problem has been so long delayed.

Having identified the difficulties, we are in a better position to attack the problem successfully. In the first place, it is clear that the stage-classification made before operation cannot be accurate, only approximate. But by utilization of all the factors which help toward accuracy, the preoperative classification may be made to approximate so closely the actual extent as to be of material assistance in the selection of treatment for that patient. The first task is to define the stages in terms of pathologic extent, and the second and more difficult task is to devise a plan of recognizing the stages approximately before operation.

The Stages. The division of a continuous process into stages necessitates dealing with borderline areas about which there may be differences of opinion as to preferable assignment. The important thing, however, is not exactly where the lines of division are placed but that they should be placed definitely somewhere, and then that this definite classification be used in all clinical work and in all reports of cases. The following classification into stages is definite and practical, and stands the test of application in the examining room and at the operating table and in the laboratory. Each of these stages was selected with two points in view: first, to have its limits correspond with anatomic lines as far as practicable so as to be well defined and easily described, and second, to have it recognizable clinically before operation as far as possible with the various helps available. The six stages, each representing a definite extent of involvement, are as follows:

Stage I: Endometrium alone involved (Fig. 834).

Stage II: Definite involvement of the muscular wall, but not beyond its middle (Fig. 835).

Stage III: Extension to the outer half of the uterine wall, but not beyond the borders of the uterus (Fig. 836). This includes extension to the peritoneal coat with possible areas of adhesive peritonitis, but without carcinomatous involvement of the adhesions.

Stage IV: Extension to surrounding structures but not beyond removable ones, such as adnexa and adjacent portions of the broad ligaments (Fig. 837). There may or may not be extensive intestinal or other peritoneal adhesions, but no extension of carcinoma cells into such adhesions.

Stage V: Extension into structures not advisable to remove, but removal of the original tumor is still practicable. The carcinomatous extension may be into an adherent coil of intestine or an adherent area of bladder wall, or it may be along the broad-ligament lymphatics into the deep structures of the pelvic wall (Fig. 838).

Stage VI: There is such extensive involvement of surrounding structures that not even the main tumor mass can be safely removed (Fig. 839).

Clinical Recognition of Stages.— Clinical recognition or identification of the stage in a particular case is useful in two ways, namely, in accurate reporting of the case and in selection of treatment for the patient. Identification of the stage of involvement for case reporting is a comparatively simple matter, because the report is made after treatment, and hence, in most cases the uterus
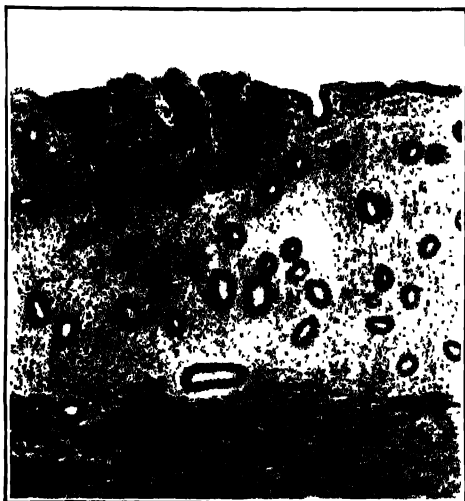
Fig. 834.   Fig. 835.   Fig 836

Figs. 834 to 838 show the clinical stages of corpus cancer, as detailed in the text (Crossen and Crossen—*Operative Gynecology.*)

Fig. 834.—First stage. Endometrium only involved.

Fig. 835.—Second stage. The myometrium involved, but not beyond the middle.

Fig. 836—Third stage. Myometrium extensively involved (past middle).

Fig. 837.   Fig. 838.

Fig. 837.—Fourth stage. Involvement of adjacent removable structures (in this case the ovary).

Fig. 838.—Fifth stage. Involvement of irremovable structures (in this case the deep pelvic glands), but the primary tumor-mass may still be removed.

is out and available for sectioning. Identification of the stage of involvement for the selection of treatment is a much more difficult matter, for it must be made before the uterus is removed.

There are a number of factors concerned in the early identification of the stage of involvement, early enough to be of assistance in deciding what treatment to give the patient. These factors are as follows: History of the case, pelvic examination, curettage-exploration of cavity and deep pelvic palpation under anesthesia, microscopic examination of curettings, and special examination methods, including gastrointestinal x-ray and cysto-scopic examination. Each of these factors is considered in detail in the article in which this subject is presented ("Clinical Classification of Cases of Carcinoma of Corpus Uteri" —see Reference List) along with the following summary. The grouping is into six stages, each stage representing an extent of involvement within fairly definite anatomic limits. The limits are capable of recognition and easy designation by the combination of opera-tive and laboratory examinations. Stages III, IV, V, and VI may ordinarily be recognized at operation and Stages I, II, III, and IV may be recognized in the laboratory. The labo-ratory examination may identify even Stage V by critical examination of the gross speci-men and selection of blocks at its margin where the cancerous extension to irremovable tissue was cut across in the operation.

Fig. 839.—Sixth stage. Involvement of surrounding structures to such an extent as to preclude even palliative removal of the main tumor-mass.

Each stage has also a clinical significance of its own, bearing on treatment or prog-nosis, as explained in detail later when dealing with treatment for the different stages.

Why six stages? Six stages may at first thought seem a rather large number. It seemed so to us, and much study was given to trying to reduce the number. But carefully considered from the standpoint of accurate definition of each stage and the classification's usefulness in clinical and laboratory work, the six stages were found necessary. A reduction in number by combining any two of them was unsatisfactory. For example, if Stage 1 in-cluded I and II and the operator received a laboratory report stating "Corpus carcinoma, clinical Stage I," he would at once wish to know whether or not it had extended to the muscular wall, because of the difference in clinical significance. If Stage II were extended to include all muscular involvement, neither the clinician nor the pathologist would be satisfied with that broad designation, for each would wish to have stated clearly whether the cancer involved only a small part of the muscular wall or extended into the outer half. The same objection applies to any combination of two stages, and still more to any com-bination of three. Careful critical study of the six stages in practical application to clini-

cal and pathologic work shows that each stage represents a definite step in the progress of the cancerous infiltration and is of importance to the clinician in treatment and prognosis.

Treatment

The treatment of carcinoma of the corpus differs from that of carcinoma of the cervix in that the radical operation is still an important factor in the handling of corpus cancer. Radiation is used in all cases, and is our sole reliance in the inoperable cases. In the ordinary case, however, operation is added to the radiation. There are certain special features in corpus cancer which make operation more effective than in cervix cancer. For example, in carcinoma of the corpus the growth starts in the endometrium, hence bleed-
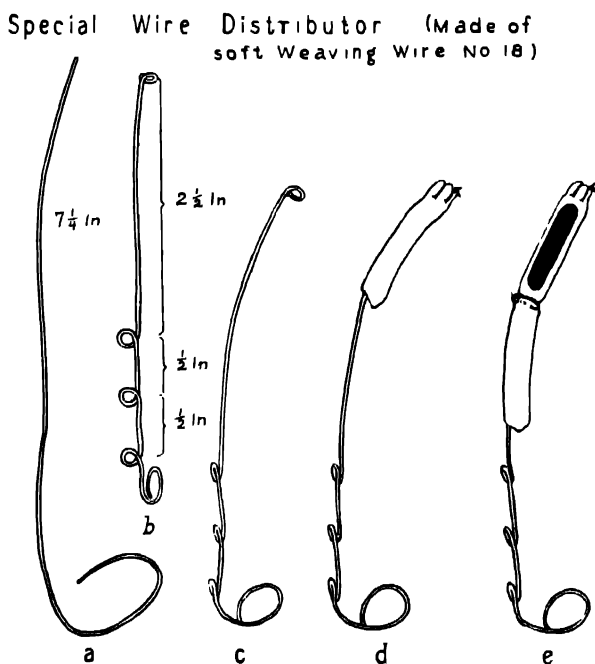
Fig. 840.—Details of the wire distributor devised by Crossen. a. The piece of pliable wire, 7¼ inches long, from which the distributor is made. b. The completed distributor turned so as to show the three eyes for adjustment to uterine cavities of different length. c. A general view showing the loop handle at right angle to the row of eyes and also the eye at the inner end to which the tubing is stitched. d. Rubber tubing for a single capsule in place and stitched securely to the eye at the end of the wire. e. A two capsule length of tubing in place and one capsule fastened in it. (Crossen—*J. Missouri M. A.*)

ing occurs early. This causes the patient to seek medical advice, leading to early examination and curettage and diagnosis of malignancy. Also, there is not the silent deep penetration of cancer cells to irremovable structures before outward clinical manifestation, as so often happens in carcinoma of the cervix. Again, the anatomical relations of the corpus uteri are such that the first lymphatic extensions of the growth may be easily removed, by excision of adnexa and associated portion of broad ligaments with contained vessels, while removal of the lymphatic extensions from the cervix necessitates deep dissection and removal of the parametrium beyond the ureters—a prolonged and exhausting operation with very high mortality.

In addition to the features rendering corpus cancer more favorable for operation than cervix cancer, there are conditions which render it less favor-

able for radium treatment. Its high location in the uterus puts it out of reach of direct palpation and increases the difficulties of determining the exact location of the malignant area and the extent and direction of its progress. These difficulties interfere with accurate application of the radium for safe maximum effect. This combination of conditions makes it advisable to employ operation in addition to radiation, except in cases where there is some serious operative contraindication.

Another principle of treatment is to secure radiation-devitalization of the cancer cells *before* the general tissue disturbance of operative removal. Such devitalization effect lessens virulence and diminishes the chance of cancer cell implantation-metastasis from the operation. It also eliminates the infective uterine discharge, and thus diminishes the danger of peritonitis following the hysterectomy. The elimination of the infective uterine discharge by the radium

Introducing and Fastening the Wire Distributor
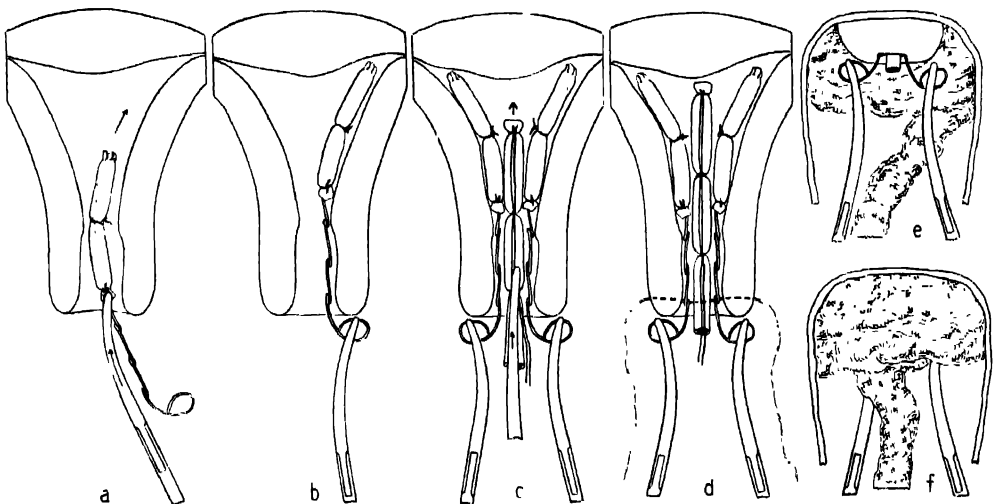
Fig. 841.—Details of the introduction and fastening of the distributor as explained in the text. a. The distributor is grasped about the middle with a strong Kelly forceps and introduced through the dilated cervix as shown b. The distributor in place and held firmly by an assistant with the Kelly forceps clamped on the handle. c. The two distributors in place and held by forceps while the tandem is being introduced between them. The firm forceps hold on the distributors is maintained until the suture, which passes through the cervix and an eye of each distributor and the tandem tubing, is in place as in d, and also until the vaseline gauze packing is in place back of the cervix (e) and in front of the cervix and extends down beyond the distributor handles as in f The forceps are then removed and the long suture is tied over the packing. (Crossen—*J. Missouri M. A.*)

radiation requires some weeks, and the process is hastened by giving the course of deep x-ray therapy in the interval, starting a week or two after the radium treatment.

An important technical feature in effective radium treatment for corpus cancer is distribution of the radium capsules in the uterine cavity and their maintenance in position and their certain removal. The reason for distributing the radium in several centers, instead of in a simple tandem as for myoma is to enable the heavier dosage required for carcinoma to be given without causing point-devitalization and sloughing. It is a difficult problem on which considerable work has been done.

The senior author recently devised a very satisfactory form of wire dis·tributor for this purpose. The experimental and clinical details concerning it will be found in the article, "Advances in the Treatment of Cancer of the Corpus Uteri." The distributor is shown in Fig. 840, the method of introducing and keeping it in place in Fig. 841, and the recommended distribution in different types of operable cases in Fig. 842.

The vaginal packing of vaseline gauze is the same as that used in radium treatment for myoma, and the method of removal is the same (Figs. 752 to 757). The matter of insuring removal of all radium capsules placed in the uterine cavity is not as simple as may appear at first thought. In a reported case an overlooked radium capsule gradually worked through the uterine wall and penetrated the intestine, eventually causing death.

OPERABLE CASES OF CORPUS CANCER
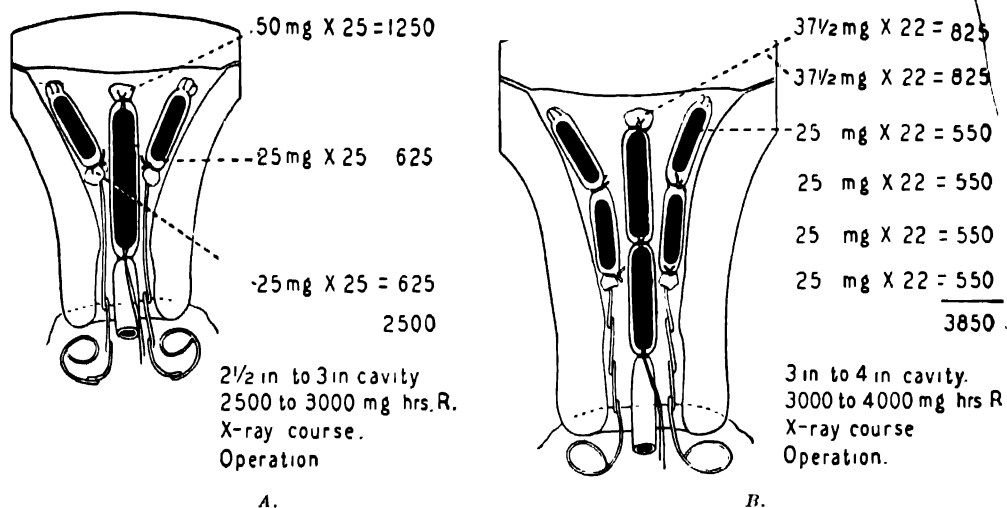
Fig. 842 —Distribution of radium and the unit dosages in operable cases of corpus cancer. *A.* A small uterus with three unit distribution. *B* A large uterus with six unit distribution (Crossen—*J. Missouri M. A.*)

Prevention of Corpus Cancer

Is there any factor entering into the causation of corpus cancer (endometrial carcinoma) which we can modify by treatment? There seems to be such a factor in association with delayed menopause. Delayed menopause or late menopause are terms used to designate that condition in which the permanent cessation of menstruation is delayed beyond the normal age. This delay is due to prolonged erratic ovarian activity and is frequently accompanied with endometrial hyperplasia.

The relationship of this undue endometrial activity in the age of declining function to the onset of endometrial carcinoma is an important subject. In this connection R. J. Crossen and J. E. Hobbs made an analysis of our cases of endometrial carcinoma and are investigating the subject in various directions. In a preliminary report (J. Missouri M. A., 1935) they presented sufficient facts

to indicate that endometrial hyperplasia in delayed menopause may be taken as a sign of a definite tendency to endometrial carcinoma.

In the clinical analysis of bleeding at the menopause age it is necessary to consider all cases of late uterine bleeding, whether or not presenting the rhythmic character of menstruation. In giving the history, patients usually regard any recurring bleeding as menstrual flow and an appearance of blood after cessation as a return of menstruation.

Accepting this composite group for investigation, pelvic examination will show the cases in which the late bleeding is due to a demonstrable local lesion, such as carcinoma of the cervix or corpus, uterine myoma, ovarian tumor, or a tumor or inflammation of some adjacent structure. Further investigation will identify the cases presenting some extrapelvic disease which may be the cause of the bleeding, such as blood dyscrasia or cardiovascular-renal hypertension or thyroid disorder.

There remains a small group of cases presenting no evident genital lesion nor extragenital disease to account for the bleeding, and in which the bleeding simulates more or less the menstrual rhythm. This is a most interesting group, presenting unsolved problems in pelvic physiology and pathology. The patients are past the usual age for normal ovarian functioning and yet they present evidence of endometrial activity dependent on ovarian activity.

Are these cases simply examples of unusual disparity between the age in years and the age in physical changes, and consequently due to run a normal course to a later menopause? Are they, on the other hand, cases representing an irregularity of functional decline which may impose a pathological influence on the cell activity of the involuting endometrium? We have given considerable thought to this interesting problem and its practical bearings, and some features were presented in an article, as above noted. The ramifications of the subject are extensive and space consuming, but the practical conclusions from our study may be stated as follows:

1. Delayed menopause, especially when delayed to the age of fifty years, means some pathological condition, either in structural change or in cell activity. The influence of persisting irregular ovarian activity on the cells of the involuting endometrium tend to erratic cell activity, thereby favoring cancer development. In our series of 89 cases of cancer of the corpus uteri, there were 30 in which there was a definite interval between the menopause and the clinical appearance of the endometrial carcinoma. In these 30 cases the menopause occurred at the age of fifty years or later in 22 or 70 per cent, and at age of forty-eight years in 3 other cases.

2. Endometrial hyperplasia in the endometrium of involutionary age seems to represent a step in the pathological progress from normal endometrium to carcinoma. Hyperplasia is a very frequent finding at curettage for bleeding in this age-period when carcinoma is most common. In our series of cases of endometrial carcinoma a few of the patients had been curetted, in their home town or elsewhere, one or two years previously. In 3 such cases the slides of the previous curettings were available for study and each of them showed definite hyperplasia at that time. Here, in this one series of cases, there were 3 instances in which curetting showed benign hyperplasia and another curetting one to two years later showed endometrial carcinoma. There was also an interesting specimen of a double uterus in which one horn showed endometrial hyperplasia and the other horn endometrial carcinoma.

3. Delayed menopause, especially when delayed to the age of fifty years, is an indication of aberrant endometrial activity and a warning of a tendency to endometrial malignancy. Consequently, appropriate treatment should be employed to stop the aberrant endometrial activity.

4. Appropriate treatment consists usually of curettage (to stop the bleeding temporarily and to furnish tissue for microscopic study), conization of the cervix if needed for chronic cervicitis, and radium treatment to stop the erratic endometrial and ovarian activity. If there is no malignancy in the curettings or in the cervical tissue, the treatment outlined is usually sufficient to prevent further trouble. If the microscopic investigation of the curettings shows that endometrial carcinoma has already developed, then radical measures for that must be employed.

Chorioepithelioma*

Chorioepithelioma is a peculiar form of carcinoma arising from the fetal cells covering the chorionic villi. A striking feature is the early penetration of blood vessels resulting in the hemorrhagic character and appearance of the growth, as shown in Fig. 843. This blood vessel penetration leads also to early metastases to distant organs, which makes it an exceedingly fatal growth. It is nearly always preceded by abnormal pregnancy terminating in hydatidiform mole, but fortunately only a small percentage of such moles are followed by chorioepithelioma.

Care should be taken to exclude this type of growth whenever there is persistent bleeding coming on some weeks or months after confinement or miscarriage. It is especially liable to occur following hydatidiform mole. Such was the history of the specimen shown in Figs. 844 and 845. This patient was first seen some months after the expulsion of a large hydatidiform mole. The immediate cause of the consultation was repeated uterine hemorrhage, difficult to control. Curettage gave tissue that showed malignant disease of the corpus uteri. A hysterectomy was done, and sectioning of the removed uterus showed a typical chorioepithelioma.

As metastases occur early, one or more of the metastatic growths may overshadow the primary uterine trouble, causing it to be overlooked. In a suspected case of chorioepithelioma, x-ray examination of the lungs should be carried out to see if any metastases are there. Also, any disturbance of other organs should be investigated with the idea that it may be metastatic from a chorioepithelioma not yet large enough to produce pelvic symptoms.

Occasionally a metastasis to the vaginal wall will furnish a clew in diagnosis, as it did in the case shown in Fig. 846, reported by Wilson. This instructive case is of unusual interest because a year and a half elapsed after the removal of an hydatidiform mole before there was any evidence of chorioepithelioma. The Friedman test became negative promptly and remained so up to the time mentioned. The patient had periodic examinations and was in good health. About two months after the last examination she was admitted to the hospital, critically ill and with a history of cough and bloody sputum for the past week, and died in five days of generalized chorioepithelioma.

Microscopic Pathology.—The characteristic cellular features of chorioepithelioma are shown in Fig. 845. The difficult problem for the pathologist comes in the differentiation of benign hydatidiform mole from borderline conditions tending toward malignancy. The problem is further complicated by the fact that the site from which the specimen came is not of great significance, for bits of normal chorionic villi may be transported to distant parts of the uterus or

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*"Chorionepithelioma" more definitely identifies the origin of this growth directly from the chorion, and this spelling may eventually prevail.
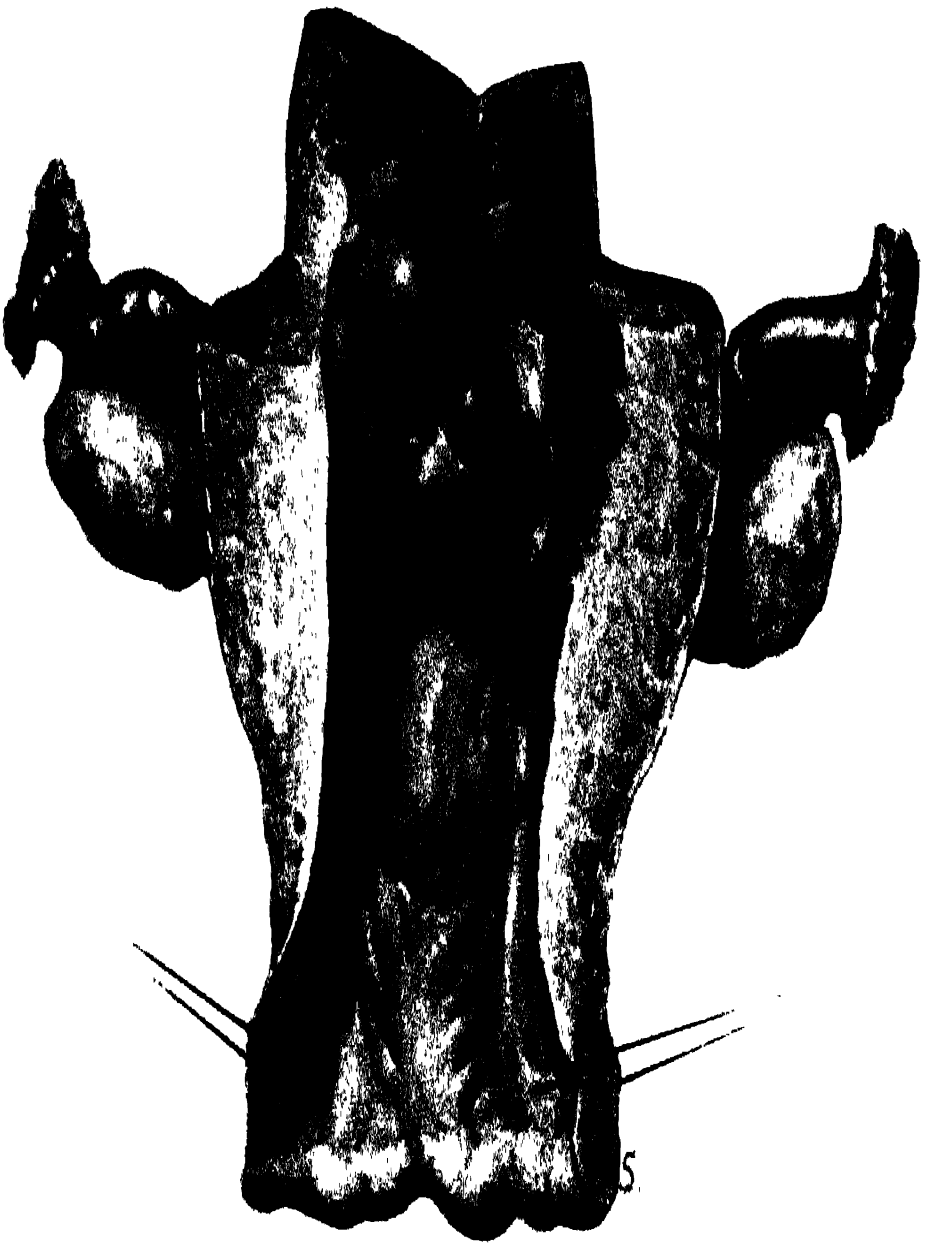
Fig. 843.—A Chorioepithelioma of the Uterus, showing the hemorrhagic character of the growth as it projects into the uterine cavity and penetrates into the uterine wall. Gyn. Lab.

even to distant organs of the body. Hence a diagnosis of, malignancy requires cell characteristics beyond normal limits or clinical features which show destructive growth.

Diagnosis.—A large percentage of chorioepitheliomas are preceded by hydatidiform mole. Any bleeding in the weeks following labor or miscarriage should arouse suspicion of hydatidiform mole and investigation accordingly. This investigation includes (a) Aschheim-Zondek test to see if patient is excreting excess gonadotropic hormones, and repetition is necessary to see if if it increasing, (b) search of uterine discharge for the little cysts of hydatidiform mole (Fig. 847) which are sometimes broken off and discharged, (c)
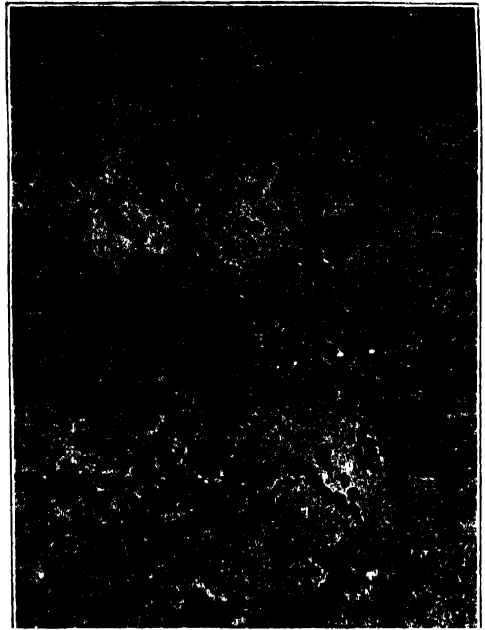
Fig. 844.   Fig. 845.

Fig. 844.—Another case of chorioepithelioma of the uterus, showing extensive involvement of the corpus uteri and a metastatic growth in the cervix. Gyn. Lab.

Fig. 845.—High power, from the specimen shown in Fig. 844. Shows syncytial cells and Langhans' cells. The latter are shown particularly well, as large light-staining cells in contrast to the darker syncytial cells. Gyn. Lab.

x-ray of lungs for metastatic nodules (Fig. 848), and (d) curettage if the bleeding tendency is not promptly stopped by medication. Though curettage must be employed with great caution and is of doubtful value in chorioepithelioma, in hydatidiform mole it is less dangerous and more certain to reveal the growth.

In chorioepithelioma, the Aschheim-Zondek test (with its modifications) assumes great importance in diagnosis. This test for excess hormones, when

strong, shows fetal elements growing somewhere, and if intrauterine and extra-
uterine pregnancy and hydatidiform mole can be excluded, chorioepithelioma is
to be suspected. The suspicion becomes stronger as the excess of hormones in-
creases, hence quantitative determination is helpful.

A most interesting case, in which the diagnosis and decision as to hyster-
ectomy had to be based practically altogether on such quantitative analysis,
was reported at the St. Louis Gynecological Society by Dr. Joseph A. Hardy, Jr.

Fig. 846.--A small chorioepithelioma deep in the wall of the uterus at the fundus, with metasta-
tic nodules in the vaginal wall. (Wilson—*Tr. Am. Gynec. Soc.*)

A patient with hydatidiform mole removed by curettage continued for a period of
several weeks to have about 100 mouse units of prolan, and then there was an astonishing
rise to 40,000 mouse units. A second curettage showed the uterine cavity clear of any evidence
of chorioepithelioma. As the high prolan excretion continued, abdominal operation for
exploration of the pelvis was decided on. Fig. 849 shows the great rise in prolan excretion
which brought the decision for operation.

Even with direct inspection and palpation of the uterus through the abdominal in-
cision, there was no definite physical evidence of a uterine growth. But the great rise in
prolan showed serious activity somewhere following the hydatidiform mole, and the uterine
wall was the most likely place for it. Hence the uterus was removed, and on sectioning it
showed a small focus of chorioepithelioma activity deep in the wall. The very early
diagnosis and operation apparently forestalled metastasis, for the prolan output returned
to normal in the course of a month and remained so.

Though the quantitative determination of the gonadotropic hormone output is the main reliance in the early diagnosis, the results of this test whether negative or positive must be *correlated* with the *history* and *examination findings*. In an instructive article on the subject, Mathieu makes the following observations:

Although all authorities agree on the value of the biologic pregnancy test in the diagnosis of mole and chorionepithelioma, it should be noted that there have been many misconceptions of the test—laboratory errors (2 per cent), too much reliance on a single test, and clinical and pathological judgment at variance with the test. The pregnancy test is always positive only if there is living chorionic tissue present or when the stored hormone has not been completely absorbed.
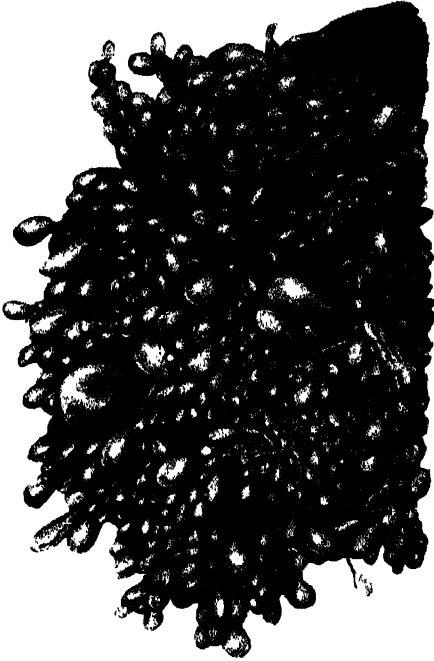
Fig. 847.   Fig. 848.

Fig. 847.—Showing the cystic character of an hydatidiform mole, from which most chorioepitheliomas originate. Vesicles may break off the mole and come away with the bloody discharge, which is often present, and search for them in a suspicious case may aid in diagnosis. Gyn. Lab.

Fig. 848.—Lung metastases from a chorioepithelioma of the uterus. Gyn. Lab.

The qualitative test is not sufficient since the increasing amount of hormone associated with these diseases is detectable only by a quantitative assay. Nevertheless, one should not overlook the fact that at about the sixtieth day of normal pregnancy there is an enormous amount of the hormone. In the pursuit of mole and chorioepithelioma by means of biologic pregnancy tests, one must be certain that normal pregnancy is not present.

Quantitative tests are at times impractical, inexpedient, or even impossible. When only qualitative tests are used, one must be aware of the following facts: (1) the test is positive in the presence of living chorionic tissue, which includes normal pregnancy; (2) the test is also positive in hydatidiform mole, chorioepithelioma, or metastases of either disease; (3) the test may be negative in missed molar abortion; (4) the test may be positive for six weeks following the passage of a mole because of stored hormone in the body; (5) if a test is positive two months after the passage of a mole, and normal pregnancy has been excluded, it is likely that living molar tissue is still present or chorioepithelioma has developed; (6) in the presence of lutein cysts after all living chorionic tissue has been removed, the test will be positive until these cysts regress because the hormone is stored

in them; (7) a positive test one month after the removal of a chorioepithelioma is strong evidence of metastasis; (8) the spinal fluid gives a negative test in normal pregnancy and a positive test in mole or chorioepithelioma; (9) absolute reliance should not be placed on one test, and in questionable cases the test should be checked and rechecked; (10) the test should be used in all questionable conditions where the element of chorioepithelioma might exist.

In the discussion of Mathieu's paper, Novak called attention to the rarity of chorioepithelioma (only 8 or 9 in the 48,000 specimens at Johns Hopkins) and then emphasized the difficulties of pathological diagnosis and the chance of a mistake as follows:

Sometimes pathologic diagnosis is quite simple, in other cases difficult. In a border-line case it is difficult to say whether we are dealing with a benign hydatidiform mole, with marked trophoblastic proliferation or with a real chorioepithelioma. When we get large masses of trophoblast growing in bulk, with few or no villi, and destroying the uterine muscle, and with abundant evidence of anaplastic activity, there is little difficulty about the diagnosis. But in a perfectly benign hydatidiform mole if the sections are from the uterine wall, where the mole is getting plenty of blood supply, and not from the vesicles in the uterine cavity, we may be confused by the large masses of trophoblastic tissue,
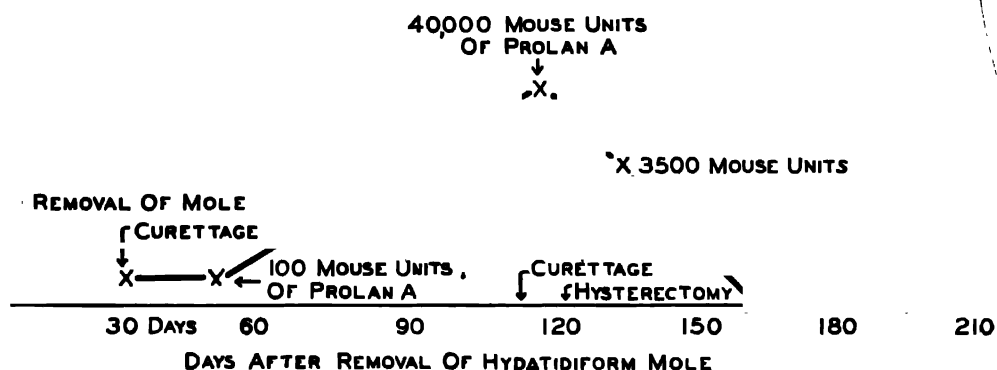
Fig. 849.—Graphic chart showing details of the case in which there was a rise of prolan to 40,000 units, which led to hysterectomy and discovery in the uterine wall of a small chorio-epithelioma which had not yet metastasized. (Case of Dr. Joseph A. Hardy, Jr., through whose courtesy this chart is reproduced.)

which nevertheless is not evidence of malignancy. I believe that many more mistakes of diagnosis are made in this particular field than in any other. Even normal pregnancy has often been mistaken for chorioepithelioma because of the frequent presence of numerous trophoblastic cells deep in the musculature beneath the implantation area, though this is entirely normal.

Cosgrove reported a series of cases of hydatid mole, the following quotation being from the summary:

This brief review of 15 cases of hydatid mole, including 3 cases complicated by chorio-epithelioma, demonstrates that in all cases the behavior of the hormone tests has been consistent with the clinical history. In two cases the hormone tests have determined early radical treatment. In one of these positive diagnosis even by exploratory curettage would have been impossible, and failure to recognize the significance of the hormonal test would have deprived the patient of early and curative treatment.

As indicated above, laboratory findings must not be regarded as wholly determinative in these cases. If they are positive they confirm the significance of the clinical behavior. Negative findings, however, cannot be implicitly relied upon.

Concerning the troublesome and sometimes misleading variations in prolan output in hydatidiform mole and chorioepithelioma, the following conclusions were reached by Payne in a recent article on hormone studies in the presence of hydatidiform mole and chorioepithelioma.

The curve of prolan concentrations during normal pregnancy serves as a valuable standard for comparison in the interpretation of abnormal concentrations that are prone to occur in the presence of hydatidiform mole and chorioepithelioma.

Analyses of the clinical picture, the prolan values and the pathological findings of hydatidiform mole disclose that any of 4 types of molar activity may be encountered. Since each type presents distinctive clinical and hormonal characteristics, both aspects must be considered in its identification.

Following molar evacuation, regularly spaced hormone titrations for a year are necessary to differentiate between recovery and the development of chorioepithelioma. An increase in prolan values denotes the presence of malignant degeneration or intervening pregnancy, while a gradual decline or the lack of an increase, even over a considerable period of time, indicates the absence of chorioepithelioma.

In the diagnosis of chorioepithelioma, repeated quantitative prolan titrations are invaluable. The final decision does not rest upon a single qualitative or quantitative determination but upon the demonstration of increased values over a short period of observation.

Following treatment for chorioepithelioma, quantitative hormone studies are useful both as a prognostic aid and as a guide to subsequent treatment.

Treatment.—Though chorioepithelioma may metastasize early and run a rapid course to death, the operative treatment has not now the almost hopeless outlook of earlier years. There are two factors responsible for this improved outlook. Operative treatment has shown that some of the fairly advanced tumors are still localized and may be cured by hysterectomy.

The other factor, and the main one in the improved outlook, is the possibility of early diagnosis by careful watching and the employment of the means mentioned under Diagnosis. In reviewing this phase of the subject Mathieu remarks: "An analysis of the extensive papers written prior to 1930, including about 1,500 cases of chorioepithelioma and probably ten times as many moles, shows that the mortality rate of mole was approximately 12 per cent and that of chorioepithelioma 60 per cent. A review of the world's literature for the last three years, involving 576 cases of mole and 266 of chorioepithelioma, shows the mortality rate now to be approximately 2 per cent and 10 per cent, respectively."

A study of recent literature shows that the patient was almost invariably cured when the disease was diagnosed early and hysterectomy performed immediately.

We are inclined to think of chorioepithelioma as a pregnancy tumor only and confined to the female, but such is not the case. The bisexual nature of both male and female is emphasized by the occurrence of chorioepithelioma in the testicle and of arrhenoblastoma in the ovary. Two cases of chorioepithelioma of the testicle were reported, with review of literature, by Fortner and Owen.

SARCOMA OF THE UTERUS

A sarcoma is a malignant growth arising from connective tissue or connective tissue derivatives. Sarcoma differs from carcinoma in that it may

occur at any age (though more frequently between the ages of thirty and
sixty), and furthermore it is not especially associated with childbearing. This
form of cancer of the corpus uteri usually starts in a myoma which has begun
to degenerate, though occasionally sarcoma starts in the connective tissue of
the endometrium. It is in the larger myoma nodules that circulatory disturb-

Fig. 850.—Sarcoma originating in an encapsulated intramural myoma about 8 cm. in
diameter. At the left is the endometrium, in the center muscle tissue of the uterine wall and at
the right the edge of the sarcomatous nodule. Gyn. Lab.
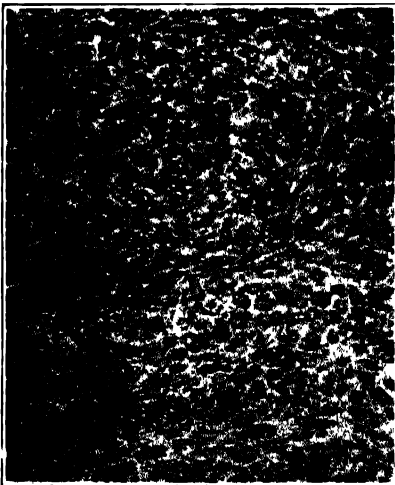
Fig. 851.   Fig. 852.

Fig. 851.—Sarcomatous change in submucous myoma. High power of Fig. 850. Large
cells, chiefly spindle, occasional mitotic figure in field.
Fig. 852.—Photomicrograph of section from the tumor shown in Fig. 853. Gyn. Lab.
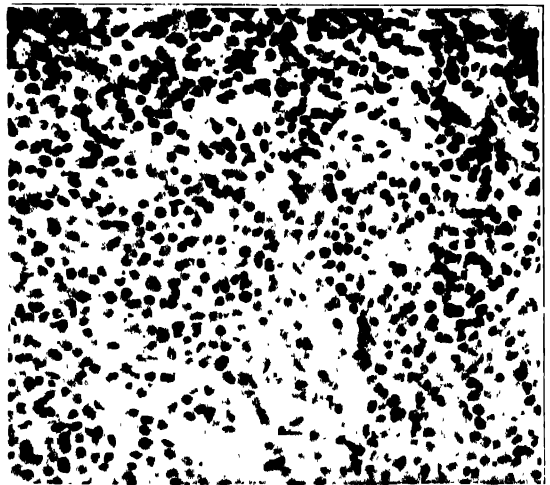
ance occurs with resulting degeneration of various types. It seems that the
erratic cell activity of ordinary degenerative changes continued over a long
period favors sarcoma development.

Fig. 853.—Section through a sarcoma originating in a myoma of the uterus. This speci-
men is unusual in that the sarcomatous change is so uniform throughout the large tumor. A
cross-section of the uterus is seen at the lower right corner. Gyn. Lab.
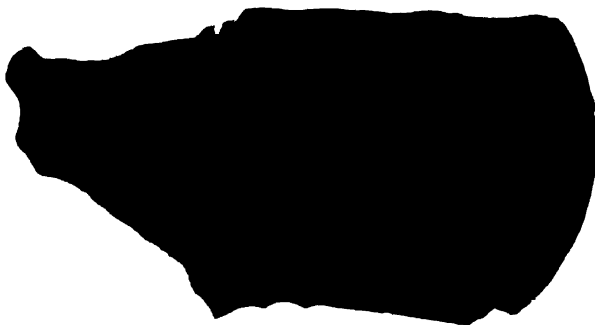
Fig. 854.—Sarcoma of the endometrium. The sarcomatous area is to the right. Notice the
distinct line of demarcation between it and the normal portion of the uterine wall underneath.
Gyn. Lab.

A.   B.

Fig. 855.—Sarcoma of the endometrium. Photomicrographs from the growing edge of the tumor shown in Fig. 854. *A*, Low power, showing the line of junction of the sarcoma (above) with the normal wall. *B*, High power of the contact area. Gyn. Lab.
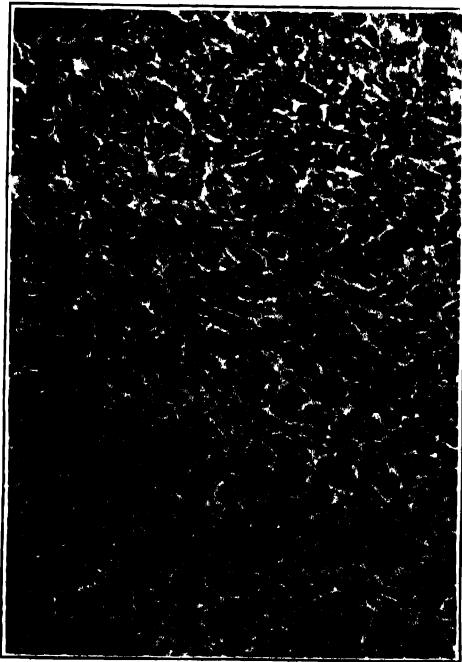
Fig. 856.   Fig. 857.

Fig. 856.—Sarcoma of the endometrium. High power, from the section shown in Fig. 854. This is the round-celled type of sarcoma. The appearance in the spindle-celled type of sarcoma is shown in Fig. 857.

Fig. 857.—Curetting. Sarcoma of endometrium. Spindle-celled type. Gyn. Lab.

Fig. 858.—Polyp protruding from the cervix, which on removal and submission to routine microscopic examination proved to be sarcomatous. The uterus was then removed and when opened revealed the condition shown in Fig. 859. Gyn. Lab.
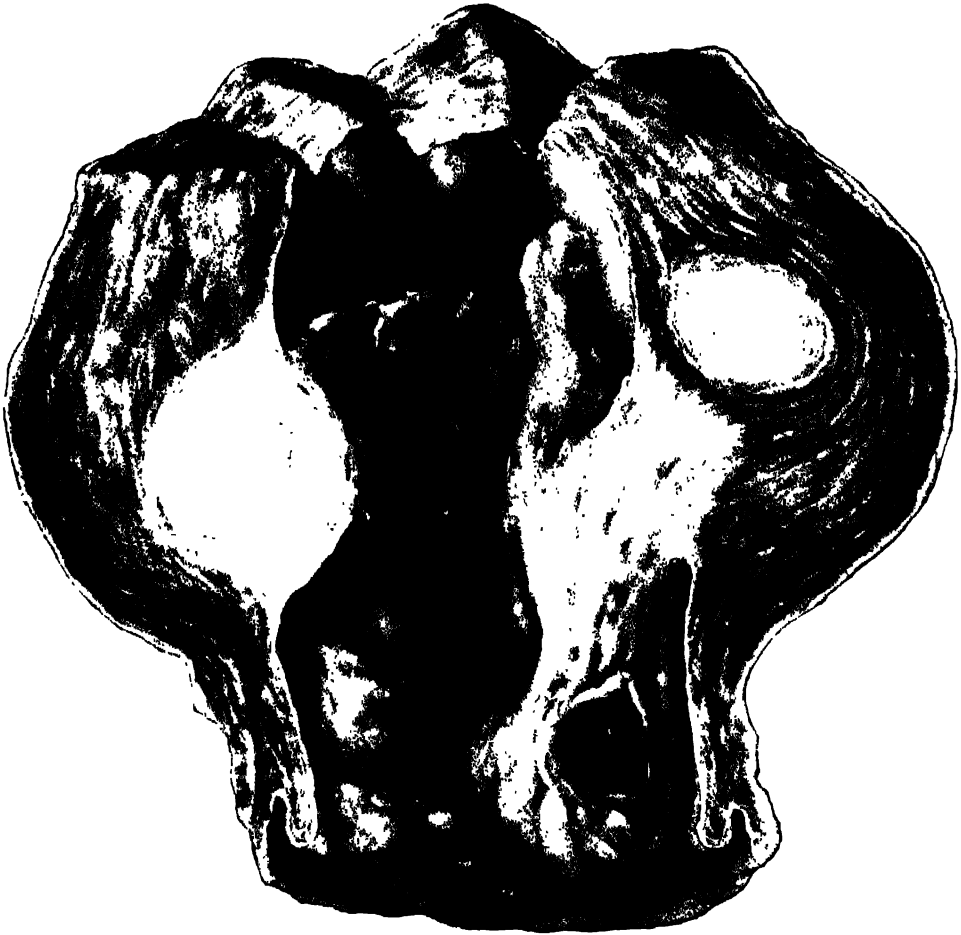
Fig. 859.—Extensive sarcoma of the corpus uteri originating in the endometrium. The exuberant growth formed polypoid masses which from time to time projected from the cervix (see Fig. 858) and were removed as simple cervical polypi. This happened several times before the patient came under the authors' care. Gyn. Lab.

Pathology

A sarcoma originating in a myoma is shown in Fig. 850, the point of contact with healthy uterine wall being shown. Higher magnification of the structure of this tumor is seen in Fig. 851. A very large sarcoma originating from a myoma is shown in the gross with uterus attached in Fig. 853, and the microscopic structure in Fig. 852. Sarcoma originating in the stroma of the endometrium is shown in Fig. 854. It has invaded the myometrium. Notice the distinct line marking the limit of invasion. This line is shown also in Fig. 855. This is the round-cell type as shown in Fig. 856. The microscopic appearance of the spindle-cell sarcoma of the endometrium is shown in Fig. 857, which is from a curetting resulting in diagnosis.
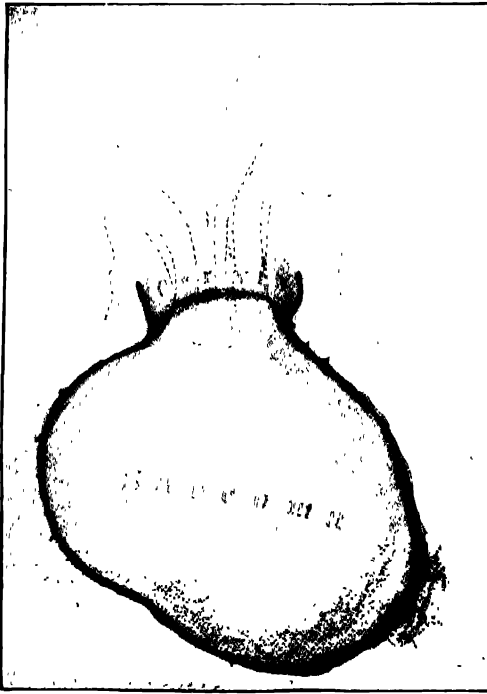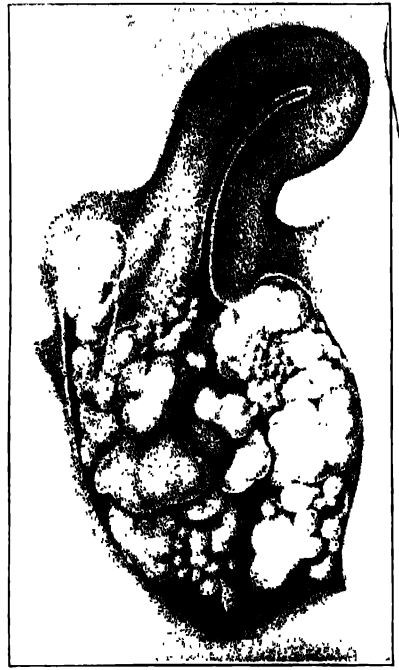
Fig. 860.   Fig. 861.

Fig. 860.—A sarcoma of the uterus projecting into the vagina and causing partial inversion of the uterus. (Kelly—*Operative Gynecology*, D. Appleton-Century Company.)

Fig. 861.—Grapelike sarcoma springing from the cervix uteri and forming a mass in the vagina. (Kuestner—*Kurzes Lehrbuch der Gynaekologie*.)

Sarcoma of the uterus occurs usually as a mixed cell sarcoma containing large spindle cells and giant cells. Rather characteristic of uterine sarcoma is the great diversity in size and shape of the cells. Large round-celled sarcoma is occasionally encountered and very rarely a tumor of the small round-celled type. The differential diagnosis from myoma is not always easy since non-malignant myomas frequently contain giant cells and mitotic figures.

Occasionally a sarcoma of the endometrium forms polypi which project from the cervix and may be mistaken for a simple mucous polyp of the cervix. Such a case is shown in Fig. 858, and it illustrates the importance of microscopic examination of all tissue removed from the cervix. The patient gave

a history of having had a "simple" polyp removed from the cervix twice. There was no microscopic examination. As the polyp returned, she decided to go to another physician for a more thorough investigation. Examination showed a soft polyp projecting at the external os. This was removed and sent for routine microscopic examination, and it showed sarcoma. The uterus was then removed, and it showed extensive sarcoma of the endometrium (Fig. 859), which had been growing all this time.

The fact that sarcoma usually originates in a myoma should be kept in mind in operations for myoma. On this account the opening of the uterus, as soon as removed at operation to see if there is any malignancy, should include the opening of all the large myoma nodules to see whether there is any evidence of sarcoma. If so, the adnexa and upper part of each broad ligament should be removed, and later deep x-ray therapy employed.

A pedicled sarcoma causing partial inversion of the uterus is shown in Fig. 860, and a grapelike sarcoma springing from the cervix, a rare type, is shown in Fig. 861.

Treatment

The treatment for sarcoma of the uterus is ordinarily prompt hysterectomy with removal of adnexa, followed by deep x-ray therapy. Special conditions may call for special modifications and in inoperable cases radiation is the main reliance.

McDonald, Broders and Counseller reported a series of 20 cases of uterine sarcoma, originating in the endometrium, with pathological and clinical analysis. The disease brought high mortality, both immediate from the operation, and later from recurrences. Three patients were cured (six-year check-up) and one was well at three years. Hysterectomy was employed in all but three cases, with radium and x-ray supplementing in some. The surviving cases all had hysterectomy.

PELVIC INFLAMMATION

Pelvic inflammation is the term applied to inflammation in the pelvis outside the uterus. The inflammatory process may be located in the fallopian tubes, in which case it is called "salpingitis," or it may be in the ovary, in which case it is called "oophoritis," or in the peritoneum, where it is known as "pelvic peritonitis," or it may be in the connective tissue, where it constitutes "pelvic cellulitis." The cause of these various forms of inflammation is the same—viz., infection—the symptoms are much the same, the treatment is in many respects the same, and two or three of the lesions are usually associated—in some cases so intimately associated that it is difficult to determine which is predominant. Consequently, it is convenient to group these lesions due to pus bacteria under the general term, pelvic inflammation, which at once identifies the type of process affecting the patient.

The continuous opening by which infection travels from outside the body into the peritoneal cavity is shown in Fig. 862. This continuous cavity is a large factor in the greater frequency of pelvic peritonitis in women than in men. There are narrowings which tend to check the upward progress of infection, for example, the external os and internal os and the uterine openings of the tubes. The mucus-filled cervical canal acts in the adult as an effective barrier to the upward extension of pathogenic bacteria, except the gonococcus, and even the gonococcus may be delayed and sometimes stopped by the protective qualities of the undisturbed canal contents. However, instrumentation in the canal interferes with this protective function and favors upward progress of any infection present. Hence, instrumentation within the uterus should be carried out only when indicated by conditions warranting the risk, and then under strict aseptic precautions.

The clinical differences between the acute and chronic forms of pelvic inflammation are greater than between the separate lesions, which fact indicates the two main divisions of the subject.

ACUTE PELVIC INFLAMMATION

The cause of acute pelvic inflammation is bacterial infection. The infection may be with the ordinary pus germs (staphylococcus and streptococcus) or with the gonococcus. Practically every case of primary acute pelvic inflammation in the adult can be traced to infection from **labor,** from **abortion,** from **instrumentation,** or from **gonorrhea.** Secondary inflammation of the genital organs may be caused by extension from an inflammatory focus in some adjacent organ—e.g., the appendix or the bladder or from some general disease, particularly mumps or scarlet fever.

In a large proportion of the cases of pelvic inflammation, particularly the gonorrheal cases, the infection extends by way of the uterine mucosa to the fallopian tubes, as indicated in Fig. 863, and through the tubes to the peritoneum and other pelvic structures. In puerperal metritis (streptococcic or staphylococcic) the infection more often extends by way of the lymphatics directly through the wall of the uterus, from the endometrium to the connective tissue as shown in Fig. 864. Another avenue of entrance is through the
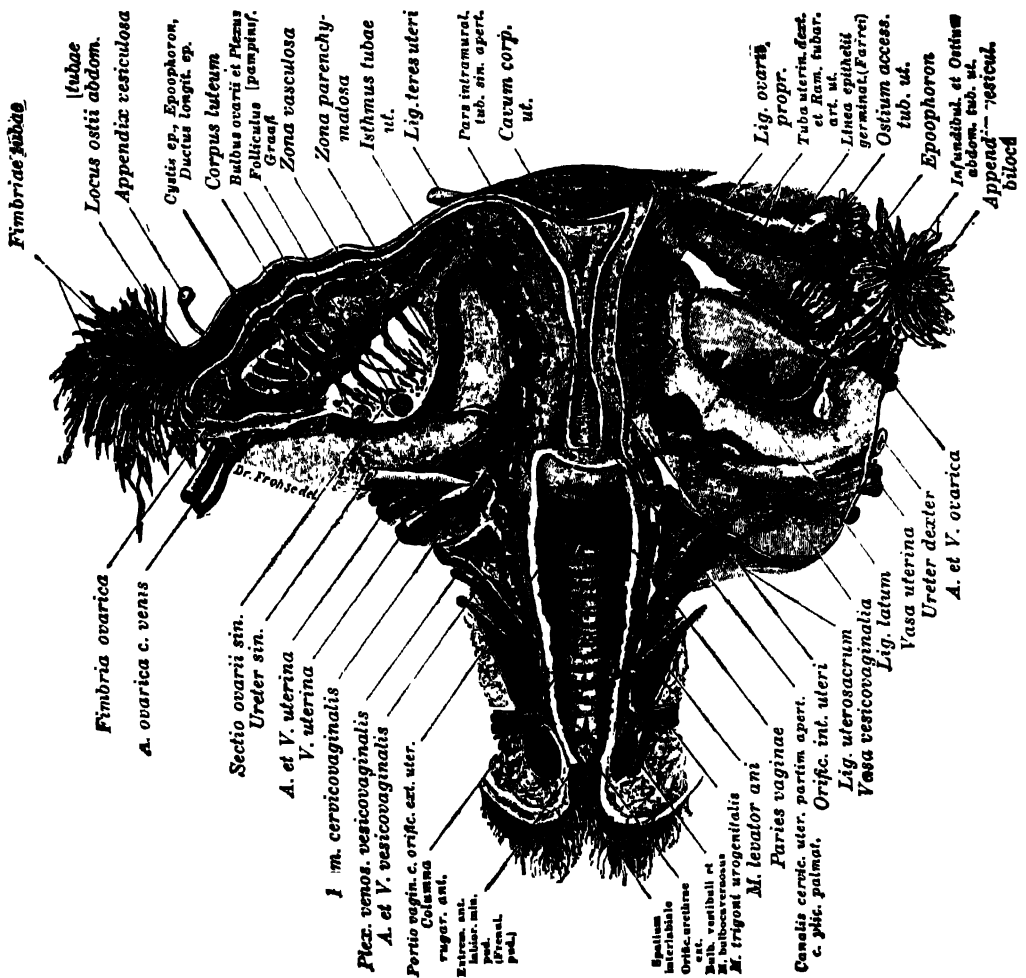
Fig. 862.—A diagrammatic section of the genital canal. Notice the continuous opening from the vulva through the vagina, uterus, and fallopian tubes to the peritoneal cavity. This is the reason genital infection extends to the peritoneal cavity so much more frequently in women than in men. (Waldeyer—*Das Becken.*)

thrombosed sinuses of the puerperal uterus. Infection of these sinuses leads to infective thrombosis of the broad ligament veins (Fig. 865), resulting in broad ligament abscess or general pyemia or both.

The fact that nearly every case of pelvic inflammation is due to an infected endometritis emphasizes the importance of checking endometritis at once when present, and of preventing it whenever possible.

Types of Lesions

The pathologic changes are varied. There are hardly two cases exactly alike and the same case presents a very different picture at different periods. However, the cases may be divided somewhat into classes, as follows:

1. **Mild Salpingitis.**—The inflammation is very slight. There is some round-celled infiltration of the wall of the tube, with slight thickening and hardening, and a few fimbriae bound together. Both ends of the tube are open. This is the mildest form of pelvic inflammation, and, as a rule, gives rise to very few symptoms. A more severe type of the same class is that in which both ends of the tube are occluded, the fimbriae matted together, and the tube distorted and often adherent to the ovary or to some other structure. The wall of the tube is thickened, but the cavity contains no appreciable amount of fluid.

2. **Salpingitis with Exudate.**—In the cases of this class there is a large amount of exudate, binding together the tubes, ovaries, intestines, and uterus, but there is no distinct collection of pus.

3. **Pyosalpinx (Tubal Abscess).**—The tube is distended with pus and there are the usual evidences of inflammation within and without the tube, but no pus outside the tube. There may or may not be a large mass of exudate. In exceptional cases the infection may localize in the ovary instead of in the tube, causing an **ovarian abscess.** In still other cases the abscess cavity involves both the tube and the ovary, forming the **tuboovarian abscess.**

4. **Diffuse Suppuration in Pelvis.**—In this fourth class the pus itself has extended outside the tube, the fibrinous exudate always extending before it and shutting it off from the general peritoneal cavity. This may result simply in an abscess low in the pelvis, which can be easily reached and evacuated from below, or the inflammation may extend until all the pelvic organs are bound together in an irregular mass (Fig. 866), with pus lying in the spaces between them and burrowing into the connective tissue. In such a case there are present all the lesions of pelvic inflammation—salpingitis, oophoritis, peritonitis, and cellulitis.

5. **Acute Diffuse Peritonitis.**—In cases of this class the infection is so virulent and spreads so rapidly that but little limiting exudate is formed. The infection quickly involves the general peritoneal cavity and causes a fatal peritonitis. This is an unusual form of pelvic inflammation and is found principally in cases of severe sepsis following labor or abortion.

6. **Cellulitis** (Fig. 867) is largely a lymphangitis of the connective tissue about the uterus. It is due usually to the streptococcus, the staphylococcus or the colon bacillus—rarely, if ever, to the gonococcus alone. Cellulitis is favored by deep laceration of the cervix, which opens up the connective area beside the uterus. Pelvic cellulitis, like inflammation of connective tissue elsewhere, may end in resolution or abscess formation or general sepsis. If resolution takes place or if an abscess forms and is opened, the inflammation subsides, leaving only infiltration and scar tissue, which causes but few symptoms aside from distortion of the parts. The inflammation may, however, extend to the peritoneum, in which cases there are added the evidences of pelvic peritonitis.

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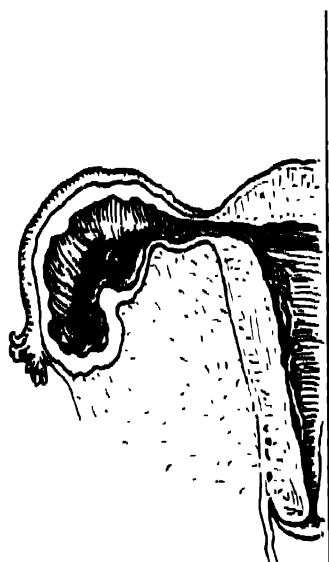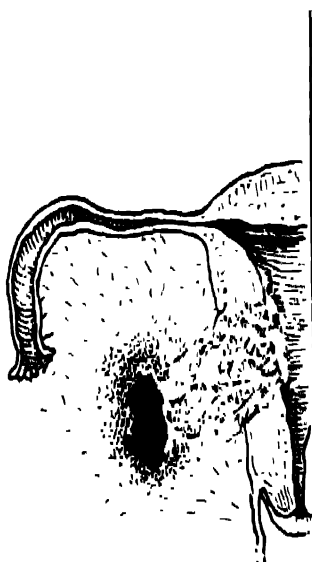
Fig. 863.   Fig. 864.   Fig. 865.

Figs. 863 to 865.—Comparing and Contrasting the Gonococcic and Streptococcic Types of Pelvic Inflammation. The clinical significance of this distinction is very great.

A gonococcic pus collection (in a closed cavity) usually undergoes automatic sterilization in three or four months, and hence may be removed by intraperitoneal operation with fair safety after that time. In a streptococcic or staphylococcic mass the bacteria are likely to continue virulent a much longer time, even for years. Hence intraperitoneal operation is contraindicated for any mass of streptococcic or staphylococcic origin. Such an abscess should be drained extraperitoneally if possible. Intraperitoneal operation is indicated only when all other methods of treatment fail and the chance of fatal peritonitis is outweighed by the danger of failing strength.

These two types of pelvic inflammatory mass may usually be readily identified by attention to the two distinguishing features, namely, the apparent *cause* of the trouble and the *location* of the mass, as explained in the text.

Fig. 863.—Gonococcic inflammation extending along the mucous membrane, from within the uterus out into the tube.

Fig. 864.—Streptococcic or staphylococcic inflammation extending outward in the lymphatics of the uterine wall to the connective tissue of the broad ligament.

Fig. 865.—Streptococcic or staphylococcic inflammation extending outward in the veins of the uterine wall to the veins of the broad ligament.

Fig. 866.
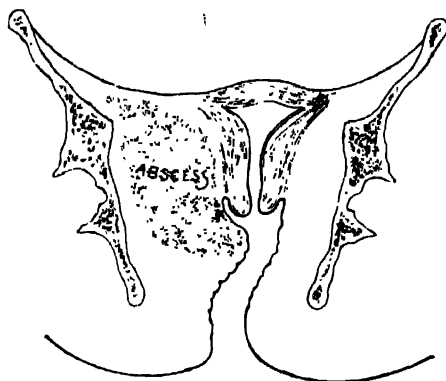
Fig. 867.

Fig. 866.—Inflammatory exudate filling the pelvis and forming a firm roof above the examining fingers. The resisting "roof" of an extensive inflammatory mass usually follows about the line here indicated. (Montgomery—*Practical Gynecology*.)

Fig. 867.—Mass beside uterus, formed by abscess in broad ligament. (Montgomery—*Practical Gynecology*, The Blakiston Company.)

7. **Septic Thrombosis** comes from infection of the normal thrombi filling the uterine sinuses after labor. It constitutes a severe and often fatal form of puerperal sepsis. In the effort to limit the infective and destructive process in the sinus or vein, another thrombus is formed proximal to the infected one. If the infection extends into the new thrombus, a portion of the vein proximal to that in turn becomes thrombosed. This process may keep on until the veins of the broad ligament become extensively thrombosed. If the infection enters through the upper part of the uterus (the usual placental site), it affects the ovarian veins in the upper part of the broad ligament (Fig. 865). If it enters through the lower portions of the uterus, the resulting septic thrombosis affects the uterine veins lower in the broad ligament (Fig. 865).

If the process is limited to this region, pockets of pus may form in the thrombosed veins and break into the connective tissue, forming a pelvic abscess, which can be recognized and opened. If the process is not limited, it extends centrally—along the ovarian veins (Fig. 865) toward the vena cava, or along the lower veins to the internal iliac, the common iliac, and finally to the vena cava. When the common iliac is involved, the process extends downward also along the external iliac vein, producing the usual signs of external iliac thrombosis (so-called "milk leg"). It must be kept in mind, however, that external iliac thrombosis may or may not be a septic thrombosis, many cases occurring without any evidence of sepsis. At any stage of the septic process in the veins, infected particles may become detached and pass into the general circulation, giving rise to metastatic foci in various parts of the body, and constituting general pyemia.

Symptoms

A patient with acute pelvic inflammation complains of **pain** in the lower abdomen, increased by movements, such as walking or turning over or sitting up. She is usually confined to bed. There may be moderate **fever** (101° to 103°) or there may be high fever (105°), the high temperature being found most frequently in pelvic inflammation following labor or **miscarriage**.

There is usually a **vaginal discharge,** due to the coincident inflammation of the endometrium, and there is a **history** of a recent labor or abortion, or instrumentation or gonorrhea, or a history of a chronic endometritis due to one of these causes.

On abdominal examination the lower abdomen is found to be tender on pressure. This **tenderness** may be confined to one or both tubal regions or it may extend over all the lower abdomen. On account of this tenderness the abdominal muscles are held more or less tense, thus preventing deep palpation.

In the vaginal examination the character of the discharge is determined, indicating to some extent the etiology of the trouble, and there is noticed also the presence or absence of evidences of recent labor or miscarriage. Manipulations in the upper part of the vagina cause pain. This **tenderness** on vaginal palpation and bimanual palpation is found both in the body of the uterus and about the tube of one or both sides. If a **mass of exudate** is present, it may be felt to one side of the uterus or behind it. If the exudate is low in the pelvis—for example, in the posterior cul-de-sac or about a prolapsed ovary or tube—it may be easily felt back of the uterus just above the posterior vaginal fornix. If the exudate is situated high in the pelvis, it may require very deep bimanual palpation to detect it, and the deep bimanual palpation may be impossible at first on account of the tension of the abdominal muscles. The mass of exudate is distinguished by its being more resistant (firmer) than the surrounding tissues and more tender on pressure. The exudate may extend all around the uterus, fixing that organ as though plaster of Paris had been poured into the pelvis and had hardened there. In these cases of extensive distribution of the exudate, the sensation imparted to the examining fingers is that of a firm roof across the pelvis just above the vagina (Fig. 866). The uterus projects through this roof of exudate and is held firmly by it.

If there is **a collection of pus** of considerable size, fluctuation may be detected, the soft area being surrounded by a firm area of exudate which has not yet broken down. If there is only a small collection of pus, not large enough to give fluctuation, its presence is indicated by persistent fever and its location is shown by a point of marked tenderness. When there is an inflammatory exudate in the posterior cul-de-sac, fluctuation may in some cases be detected earlier by rectal than by vaginal examination, the rectal finger being able to palpate the posterior surface of the mass.

In **septic thrombosis** without other involvement and in puerperal pyemia there may be no evidence of pelvic peritonitis or of pelvic cellulitis—simply repeated chills and high fever without any palpable local lesion of sufficient extent to account for them. There is tenderness in the region of the veins affected, and in some cases distinct induration may be made out, particularly where there is more or less perivenous inflammation. If the infection has come through the upper part of the uterus (which is the usual location of the placental site and hence of the area of penetration), the ovarian veins are the ones most likely to be affected. In many cases they alone have been found involved. When the infection penetrates the lower part of the uterus, the uterine veins and broad ligament veins generally become affected (Fig. 865) and later the internal and common iliac veins.

Diagnosis

The diseases that may be confused with acute pelvic inflammation and that must therefore be taken into consideration in the **differential diagnosis** are as follows:

> Acute endometritis.
> Tubal pregnancy.
> Appendicitis.
> A tumor which has become gangrenous from twisted pedicle.
> A suppurating tumor (usually a dermoid cyst or a necrotic fibroid).

In acute **endometritis** the bimanual examination shows that the tenderness is limited to the uterus. There is no marked tenderness in the periuterine structures, neither is any mass found there.

Tubal Pregnancy has been mistaken so many times for ordinary pelvic inflammation that the differential diagnostic points should be considered in detail (see Tubal Pregnancy).

In **appendicitis** the pain is more likely to start as a general abdominal pain, the point of greatest tenderness and the inflammatory mass, if there is one, being in the appendix region instead of in the tubal region. In appendicitis also there is frequently a history of stomach or bowel disturbance preceding or associated with the attack of pain, while in salpingitis there is usually a history of uterine disturbance—dysmenorrhea, prolonged menstruation, vaginal discharge, and other indications of a previous or coincident uterine disease. In girls and in unmarried women an attack of inflammation low in the right side is much more likely to be appendicitis than salpingitis. In some patients both structures are involved.

In all right-sided inflammations keep in mind appendicitis. One having his mind too intent on pelvic disease may overlook this. This fact is very well illustrated by a case seen in consultation. A few days before, the physician had operated for laceration of the cervix. Following the operation the patient developed pain in the lower abdomen, rapid pulse, nausea, and fever. The symptoms were persistent and progressive, and in three days the patient's condition became alarming. Fearing acute pelvic inflammation from infection at the site of operation, he asked for a consultation. Examination showed the cervical wound to be in good condition and nothing could be found in the immediate vicinity of the uterus to account for the serious symptoms. But on searching further it was evident the patient had appendicitis, with peritonitis. The vomiting and intraabdominal disturbance following anesthesia had evidently stirred to renewed activity an old focus of inflammation about the appendix. The patient had general peritonitis and she died before the consent of her people to an operation could be secured.

In the case of a **tumor** which is **gangrenous** from twisted pedicle, the tumor has existed a long time, and one can usually get a history of pelvic disturbance caused by it, and in some cases a clear history of a tumor can be obtained. When the turning of the tumor with torsion of its pedicle takes place, that causes a sudden onset of serious symptoms—severe pain, extending more or less throughout the abdomen, and symptoms of shock. Later, as the

tumor begins to degenerate on account of the cessation of its blood supply, local peritonitis comes on, causing fever. The local peritonitis may spread and become general peritonitis, and at this stage the origin of the trouble is much obscured. Absence of evidence of infected endometritis is another important point in the differential diagnosis of this condition from ordinary pelvic inflammation, as is also the absence of fever at the onset of the trouble and for several hours afterward.

A **suppurating tumor** is usually a **dermoid cyst,** connected with the ovary, and hence gives rise to a mass in the same region in which an inflammatory mass from salpingitis would be found. When suppuration takes place in an ovarian dermoid, there is resulting local peritonitis, with fixation of the mass by adhesions. The fever and pelvic pain and marked tenderness on examination all tend to further confusion with ordinary pelvic inflammation, making the differential diagnosis often very difficult and sometimes impossible. If the patient is a girl, or a woman who has never been pregnant or had any uterine infection, the probability is in favor of dermoid tumor and against salpingitis. Two other points in favor of the mass being a dermoid tumor are (1) a history of pelvic disturbance, pointing to the existence of a tumor before the acute symptoms developed, and (2) the absence of vaginal discharge and other evidences of uterine infection.

Necrosis or suppuration within a uterine fibroid presents the evidences of inflammation added to evidences (past and present) of a fibroid tumor.

Treatment

In the treatment of acute pelvic inflammation (acute salpingitis, acute oophoritis, acute pelvic peritonitis, acute pelvic cellulitis, and all combinations of these lesions), there are employed certain measures that may be called **general measures,** because they are applicable to all cases. There are employed also other measures that may be called **special measures,** because they are applicable to special conditions only.

General Measures

The general measures indicated in the treatment of practically all cases of acute pelvic inflammation, are as follows:

1. **Rest.**—Keep the patient in bed. If the inflammation is severe, she should use the bedpan and should not be permitted to get up to a vessel beside the bed.

2. **Applications to the Lower Abdomen.**—The hot applications are usually most effective in relieving pain and the hot-air chamber is a good method of applying dry heat. In exceptional cases the cold applications give more relief.

3. **Sedatives.**—If the pain is persistent in spite of the measures already mentioned, mild sedatives should be used, such as the bromides. Avoid morphine unless the pain is so severe as to make its use imperative, for it disturbs the stomach, checks the secretions and, in addition, masks the pain to such an extent as to interfere with our knowledge of the progress of the disease. The coal-tar antipyretics are also usually best avoided for the reason that they mask the fever. The pain and the fever are two important guides as to the **progress of the inflammation,** and hence should not be masked more than

necessary. If there is much fever, cool sponging will give comfort, reduce the temperature, and stimulate the patient, and its effect can be more accurately gauged than that of internal antipyretics. If there is much pain, of course sedatives must be given in sufficient quantity to give rest. Codeine phosphate or sulphate in one-half to one grain doses disturbs the stomach less than morphia and usually gives relief. If not sufficient, then morphia will be necessary. Whenever sedatives or antipyretics are given, their effect must be allowed for in reckoning the extent or progress of the inflammation.

4. Hot Vaginal Douches.—These may be given from one to three times daily as needed to clear away any irritating discharge. The douches are regulated also as to the comfort they give the patient. If they cause discomfort and there is no discharge of importance, they may be omitted.

5. Laxatives are to be omitted in pelvic peritonitis until the inflammation is well localized, enemas being used instead, unless there is an acute gonorrhea.

Special Measures

The special measures, indicated in certain cases of acute pelvic inflammation, are presented under the following headings.

1. Internal Medication. Chemotherapy, particularly the administration of some member of the sulfanilamide group, is to be considered. These potent drugs have advantages and disadvantages, details of which are being gradually worked out. The following two quotations present in brief reliable general information pertaining to their use in serious pelvic inflammations. Further details in regard to the use of individual preparations, with particular indications and contraindications, will be found in these articles (see Reference List).

In his study of chemotherapy in obstetrics and gynecology, Douglas reported its use in 180 patients, and reached the following conclusions:

General.—1. Bacteriologic examinations of urine, blood, lochia, cervical and urethral secretions, etc., are of the greatest importance in the diagnosis, control and evaluation of chemotherapy in infections in obstetrics and gynecology.

Urinary Tract Infections.—2. Organisms of the colon aerogenes group are the chief cause of urinary tract infections, complicating obstetric and gynecologic conditions. The urine under such circumstances can usually be rendered sterile with varying amounts of sulfanilamide. Subsequent follow-up is necessary because re-infection may recur if the same conditions subsequently exist as were present prior to the initial infection.

3. The urinary tract should be free from organisms before the patient is finally discharged. It is usually more difficult to render the urine sterile where the infection has been severe or has existed over a long period of time.

4. In ante-partum bacilluria and definite pyelitis, the urine was rendered bacilli-free and kept so in 10 of 13 cases. This fact is of great importance in the prevention of pyelitis. The earlier the diagnosis and treatment, the better the results will be.

5. The primary infecting organism was eliminated from the urinary tract in 69 per cent of a group of 115 obstetric and gynecologic patients with bacilluria or pyelitis, who were treated with sulfanilamide.

Gonorrhea.—6. Employing relatively high dosage of sulfanilamide in hospitalized patients, for a relatively short period of time, gonorrhea in the female can probably be cured by the criteria of repeated cultures and smears in a large percentage of cases. The cure rate was at least 94 per cent in the 34 patients here reported.

7. For the successful and safe employment of sulfanilamide in the present state of our knowledge we are not justified in treating the disease by this means in ambulatory patients.

8. Cultures are essential for accurate diagnosis and are a much more reliable index of cure than smears alone. However, the best results are obtained when both cultures and smears are employed.

Puerperal and Postabortal Infections.—9. Prophylactic cultures should be taken where later infection appears probable.

10. Sulfanilamide is usually indicated in infections caused by hemolytic streptococci or *B. welchii.*

11. The drug is not known to exert any definite therapeutic effect in other types of infection.

Gordon and Rosenthal reported results in 125 cases and conclude as follows:

In minor febrile disturbances chemotherapy should not be used. In severe intrapartum and puerperal infections of the genital tract, sulfanilamide should be given provided the patient is in a hospital where its administration may be properly controlled. Bacteriologic diagnosis need not precede therapy, yet early recognition of the infective agent is important. Since it is probable that sulfanilamide is effective only when the *Streptococcus hemolyticus* Group A is present, administration should not be continued for longer than a week, if another organism has been isolated.

In mastitis not responding to ordinary treatment, chemotherapy should be tried. In pyelitis it is at least as effective as other methods of drug treatment. A large series of cases followed over a considerable period of time will be necessary before positive statements can be made.

Sulfanilamide should be used in gynecologic infections (1) if they are primary gonococcal, (2) if smear or culture is positive with exacerbation or reinfection of old gonococcal infection, and (3) when the *Streptococcus hemolyticus* can be demonstrated as the infective agent.

Sulfanilamide should not be given in cases of cellulitis, pelvic or abdominopelvic abscess or to patients with acute exacerbations of chronic pelvic infections with tubo-ovarian masses when the gonococcus cannot be demonstrated. Evidence accumulates that sulfanilamide should not be given to ambulatory patients.

Long, Haviland, Edwards and Bliss, in studying the dangers of the sulfanilamide group, analyzed the records of 1,588 hospitalized adults, 1,000 of whom were treated with sulfanilamide, 297 with sulfapyridine and 291 with sulfathiazole. They close their report with the following comments:

We believe that, whenever possible, it is wise to utilize every available means of laboratory control in following patients who are receiving sulfanilamide or one of its derivatives. White blood cell counts, hemoglobin and urine examinations should always be done when circumstances permit this type of control. However, we are convinced that with the exception of acute leukopenia, all the toxic manifestations of sulfanilamide or its derivatives which may occur in the first two weeks of therapy can be recognized by careful clinical observation, and we feel that no physician should hesitate to administer these drugs in therapeutically adequate amounts, provided he can see his patient at least once a day.

At the time the physician visits the patient who is receiving one of these drugs he should inquire as to his symptoms, especially in respect to headache, body aching or malaise, because these symptoms are often the precursors of many of the toxic reactions of sulfanilamide or its derivatives. In addition to an inquiry about symptoms, the scleras should be examined for the presence of jaundice, the mucous membranes for pallor and the skin for evidences of rash. The temperature should always be taken in order to detect whether drug fever is present, and if the patient says that he has been having chills and at the time that it is taken the temperature is normal, arrangements should be made to have the temperature taken frequently during the next twenty-four hours in order to determine whether or not fever is present.

No special precautions have to be observed in respect to the urine of patients who are receiving sulfanilamide, but it is highly important that the urine of patients who are receiving sulfapyridine or sulfathiazole be measured daily. This does not mean that the attendants or family of the patient have to record the urine volume in cubic centimeters or ounces, but any standard measure, whether it is only cups, will suffice. As a matter of fact, in the case of infants it would probably be satisfactory to record the number of voidings daily. In this way it is possible to detect an oliguria which may herald an approaching anuria. The daily examination of the urine under these circumstances should consist of a careful examination of a fresh specimen for gross blood, and at the same time instructions should be given to the patient's attendants to stop the drug and administer fluids in large quantities if the urine looks bloody.

Finally, one should always remember that if a patient has once had drug fever, rash, hepatitis, leukopenia, acute hemolytic anemia, injection of the scleras and conjunctivas, diarrhea or purpura haemorrhagica in the course of therapy with sulfanilamide or its derivatives he is very likely to have a second, earlier and more severe toxic reaction if the drug is administered a second time. Therefore it is highly important to determine whether or not a patient has previously had a toxic reaction in the course of therapy with one or the other of these drugs. If he gives a history of a toxic reaction in the group which we have just enumerated, it is best to give a small test dose of the drug (0.3 Gm.) and observe the patient carefully over a period of twelve hours before cautiously beginning the course of therapy. Patients who have had a toxic reaction caused by one of these drugs may have a similar reaction when another member of the sulfonamide group is prescribed.

Bacteria and immunogens also are to be considered in the treatment of pelvic inflammations which do not yield to the other measures.

2. **Heat Treatment.**—It is in acute and subacute inflammation that the special methods of applying heat find their most useful field. The hot-air chamber, the circulation of hot water in a vaginal bag, and diathermy are to be considered in this connection.

The use of the hot-air ''baker'' usually lessens the patient's local discomfort decidedly, and it may be employed from the first, once or twice daily, for periods of increasing duration.

In the cases that are not making satisfactory progress under ordinary measures, the radical application of heat by the Elliott method or by diathermy or by fever therapy is to be considered. These methods must be employed discriminately—with careful study of the local conditions present in the individual and a fair idea of just what tissue changes you are trying to bring about in that case. Details are given under Treatment Methods (Chapter III).

3. If the infection has followed **labor** or **abortion,** it is desirable to have the interior of the uterus clean. Exploration of the interior of the uterus with the finger or curette may become necessary.

4. If the infection has taken place through an **operation wound** of the cervix, remove the sutures so as to give free drainage to the inflamed area.

5. If a collection of **pus** can be felt **low** in the pelvis, open and drain it by vaginal incision. These low pelvic abscesses are usually streptococcic or staphylococcic, and start in the connective tissue of the broad ligament, though the abscess may push into the back of the pelvis or even involve the peritoneal cul-de-sac. In opening the abscess it is important to keep within the connective tissue area or, if the cul-de-sac is involved, under the protecting roof of exudate.

It requires care to open a pelvic abscess widely and safely, particularly if the pocket of pus is small. The rectum, uterus, uterine vessels, ureter, or bladder may be injured, or the abscess may not be opened and drained thoroughly enough to effect a cure.

Opening Abscess.—The steps in opening a pelvic abscess back of the uterus are shown in Figs. 868 to 871. The preliminary incision of the vaginal wall back of the cervix is usually best made by sight, with the vaginal retractor in place and the cervix raised with a tenaculum, as shown in Fig. 868. The dissection through the connective tissue is most safely and conveniently accomplished by the sense of touch alone. The speculum, or perineal retractor, is removed and two fingers are introduced into the vagina, one of the fingers being carried into the wound back of the cervix. With this finger, blunt dissection is made through the connective tissue, keeping close to the wall of the cervix, which is distinguished by its greater hardness. This dissection is facilitated by introducing the closed blunt scissors some distance ahead of the finger as shown in Fig. 869, and then opening the scissors widely. The finger is introduced into the opening thus made in the connective tissue, and the scissors are again introduced beyond the finger and opened widely. In this way a wide tract may be made rapidly through the connective tissue, and it may be made safely, provided the operator keeps close to the cervix as indicated in Fig. 869. Each arrow in this illustration may be taken to represent a forward thrust of the blunt scissors beyond the end of the finger. Notice that the direction of the dissection carries it between the uterus and the abscess instead of between the rectum and the abscess, and thus the danger of tearing into the rectum is avoided. On the other hand, the dissection must not be carried into the cervix uteri. Involvement of the tough tissue of the cervical wall is indicated by the blunt dissection becoming very difficult while still some distance from the abscess.

Puncturing the Abscess Wall.— When the wall of the abscess is reached, further advance by blunt dissection becomes difficult or impossible. This wall of dense infiltration blocking further advance is especially marked in a long-standing abscess, but it is present in acute abscesses also to a considerable extent. The blunt scissors are now exchanged for the sharp-pointed scissors (Fig. 870), and with these the puncture is made into the center of the inflammatory mass. Care must be taken to make sure that the puncture will not extend into the rectum. A hard fecal mass in the rectum may be mistaken for a portion of the inflammatory mass, or a gas-distended part of the rectum may simulate the soft, elastic feel of a fluctuating mass, or a collapsed pocket of the rectum may project between the vaginal vault and the abscess. In Fig. 869 this dangerous proximity of the rectal wall to the operative tract is well shown. If the line of blunt dissection is kept close to the uterus, the abscess wall is reached close to the uterus, with a considerable part of the abscess lying between the point of puncture and the rectum, as shown in Fig. 870. Should there be any doubt about this, leave the scissors in the tract and, with gloved fingers, make an examination per rectum. This examination gives a clear idea of the amount of tissue between the point of intended puncture (indicated by the end of the scissors) and the nearest portion of the rectal wall.

After the curved, sharp-pointed scissors have been pushed into the center of the mass, they are opened widely and then withdrawn while still wide open. This makes a large tract into the abscess. A finger is then introduced into the cavity and its wall explored for secondary pus pockets. If a fluctuating area is found, it may be opened by the finger, dressing forceps, or scissors, care being taken to avoid wounding the rectum or mistaking an adherent knuckle of intestine for a fluctuating pus pocket. While an adherent loop of intestine may feel soft and elastic, it does not present the tense fluctuation and resistance of a pus pocket, unless obstructed. In this palpation of the interior of the abscess cavity, all manipulation should be made gently, so as not to break through the protecting roof of exudate.

Drainage.—After all pus pockets are opened, introduce a good-sized drainage tube into the abscess cavity (Fig. 871). Swab out the vagina and pack it lightly with antiseptic gauze. The upper end of the gauze should be packed rather firmly into the connective tissue about
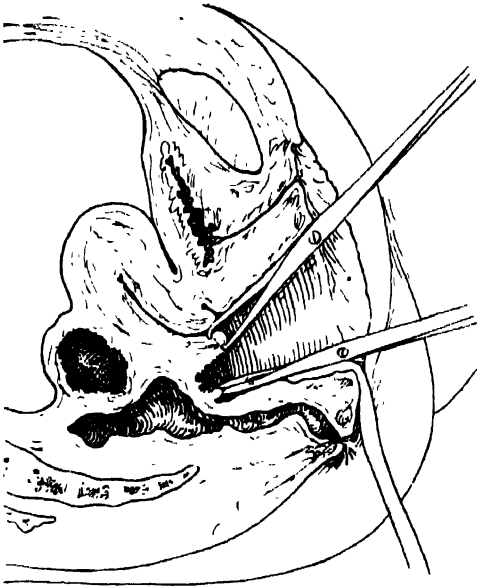
Fig. 868.
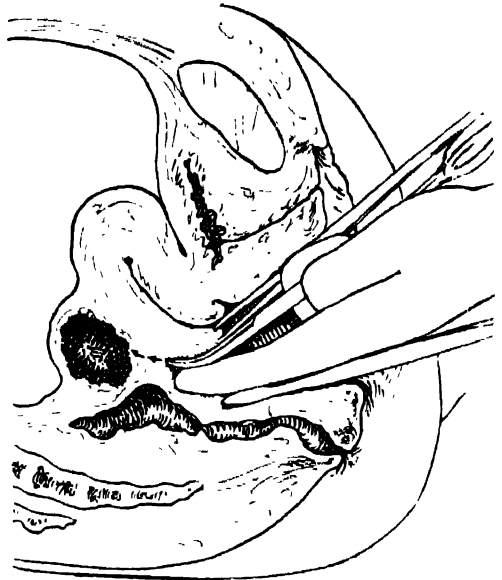
Fig. 869.

Figs. 868 and 869.—Opening a pelvic abscess. Fig. 868, Incision through vaginal wall. The retractor has been introduced, the cervix caught with a tenaculum forceps, and the vaginal wall clipped through just back of the cervix. Fig. 869, Blunt dissection through connective tissue. The retractor has been removed to permit the fingers to be introduced into the vaginal incision, and dissection is now being made through the connective tissue with fingers and blunt scissors, as described in the text. The arrows show the direction of the dissection (between abscess and uterus and not between abscess and rectum), and each arrow may be taken to represent a forward thrust of the blunt scissors beyond the end of the finger.
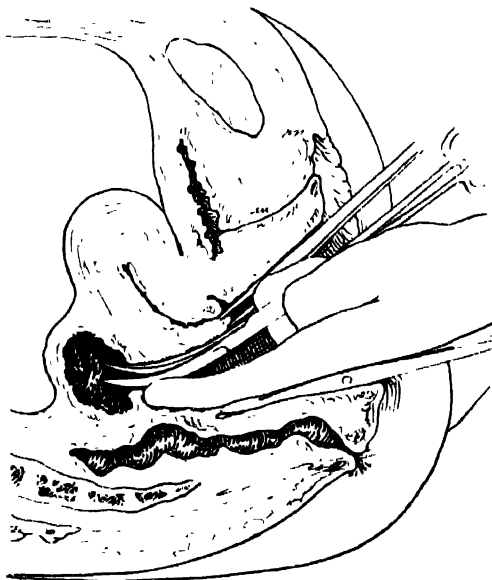
Fig. 870.
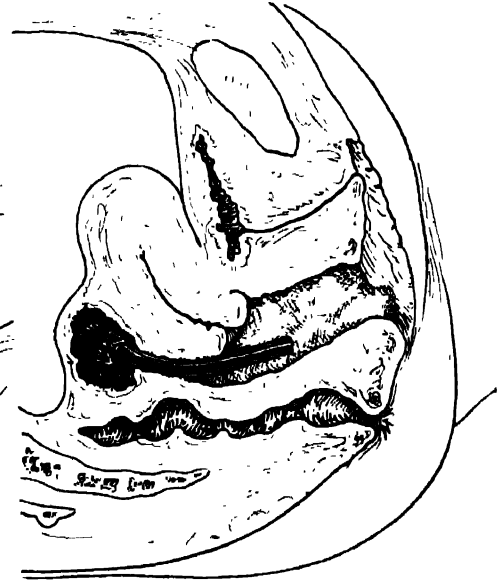
Fig. 871.

Figs. 870 and 871.—Opening a pelvic abscess. Fig. 870, Puncturing the abscess wall. The sharp-pointed scissors have been introduced into the mass under the guidance of the finger, and then opened widely. Fig. 871, Drainage tube in place. The cross-piece is to prevent the tube slipping out. The tube is cut off about midway of the vagina. The gauze packing extends into the connective tissue area about the tube, but not into the abscess cavity.

the tube, so as to stop any bleeding there. The gauze is to be packed only a short distance into the wound, so that it will not pull out the tube when it is removed, for the rubber tube is to be left in place until the cavity is nearly obliterated by granulation, which requires from two to six weeks.

The drainage tube will not stay in place without some special device. A method of forming a cross-piece on the tube is shown in Fig. 872 and another method in Fig. 873. After the tube is in place, its lower end is cut off about the middle of the vagina and the vaginal gauze packing is distributed around it. If the tube is allowed to extend out-
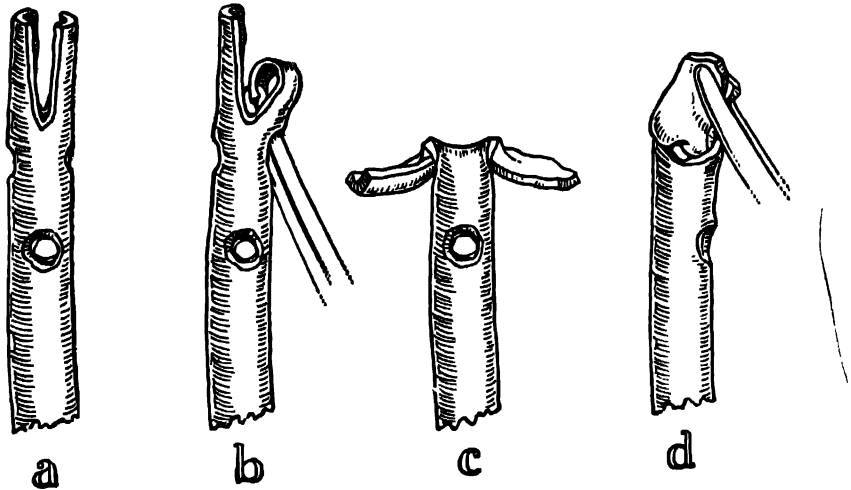
Fig. 872.—Another method of arranging the drainage tube to keep it from slipping out of the abscess cavity. *a*. The end of the drainage tube, showing the split in the end and the small opening at the base of each flap. *b*. Drawing one of the flaps through the opening at its base *c*. Both flaps drawn through. *d*. The flaps bent up and grasped with forceps preparatory to introduction of the tube into the abscess cavity. (Crossen and Crossen— *Operative Gynecology*, The C. V. Mosby Company)
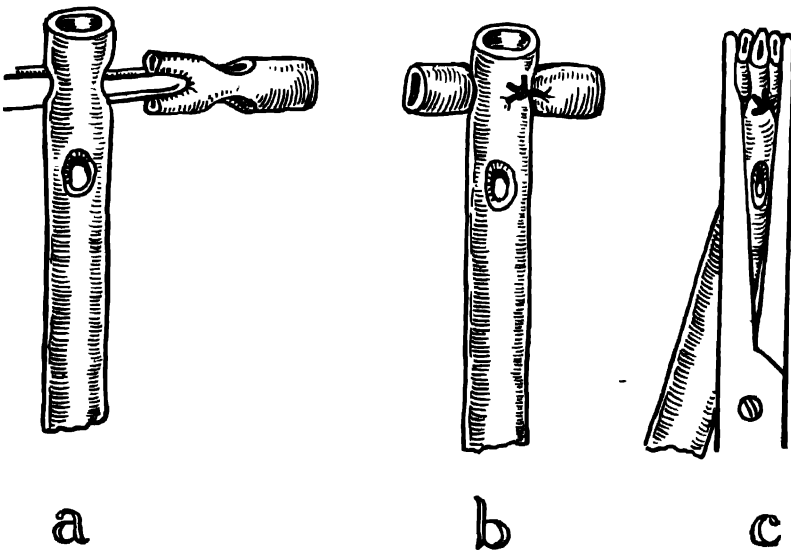
Fig. 873.—Another method of making projections on a drainage tube to keep it from slipping out of a cavity. *a*, A forceps thrust through small holes in the drainage tube and grasping a prepared cross piece, to draw it through the drainage tube. *b*, The cross piece in position, and sutured securely in place, so that it cannot be left behind when the tube is removed. *c*, The ends of the cross piece bent up and caught with a forceps, preparatory to the introduction of the tube into the cavity. (Crossen and Crossen— *Operative Gynecology*.)

side the vaginal entrance, it causes more or less irritation of the external surfaces, and if it is cut too short it may slip up into the abscess cavity and be lost.

Errors to Avoid.—It is best to *avoid irrigation* of the cavity. The free opening of the abscess relieves the tension, and this, with the subsequent drainage, is all that is required. Furthermore, if a stream of fluid is run into the cavity, it may break through some weak place in the protecting wall and cause infection of the general peritoneal cavity. Irrigation, therefore, is not only unnecessary, but also dangerous, and may cause fatal peritonitis in a patient who would have recovered promptly under simple drainage.

Another error to avoid is *dependence on gauze drainage.* A considerable proportion of failures and secondary operations are due to this. When there is a distinct abscess cavity, there will necessarily be a discharge for some time, and this discharge should find a ready exit through tube drainage. Gauze packing is very good for checking bleeding or for holding the tract open for a few days, but it is not satisfactory when prolonged drainage is necessary, and prolonged drainage is necessary in practically all cases where a distinctly
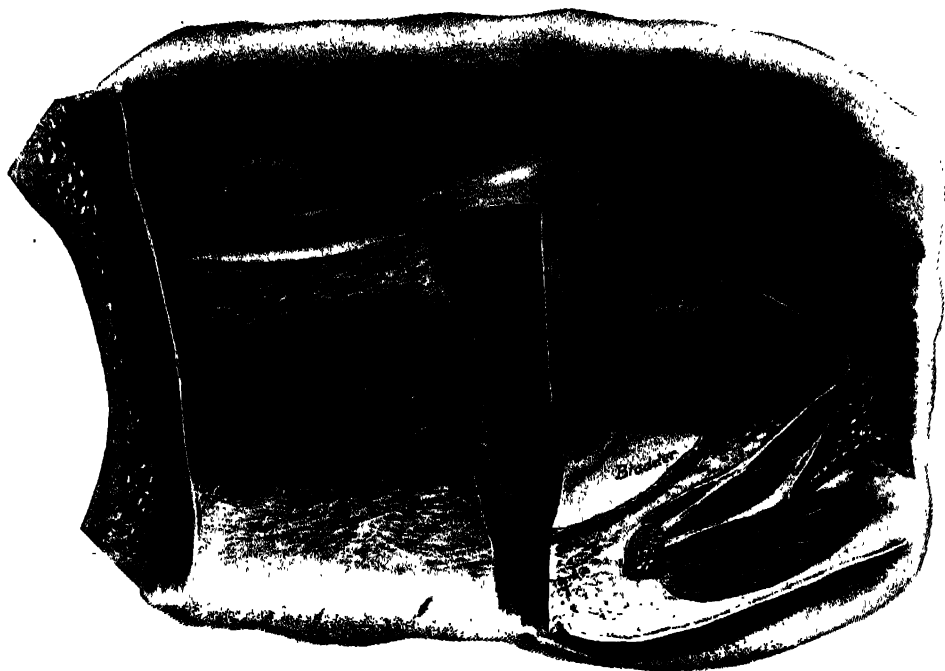
Fig. 874.—Pelvic cellulitis (parametritis). The broad ligament inflammatory mass is represented as sectioned longitudinally on the right side and transversely on the left side. The former (right side of pelvis) indicates how the infiltration extends down along the cervix and vaginal wall, and the latter (left side of pelvis) indicates how it extends forward to the bladder and also backward.

walled abscess has formed. In the crowded and contracting tissues of the pelvis, tube drainage is the only kind that will keep the drainage tract open satisfactorily and conveniently for the length of time required for a large cavity to become obliterated by granulation. And the best time to place this tube drain satisfactorily is when the patient is under the anesthetic and the abscess just opened.

Lateral Abscess.—In draining a lateral broad ligament abscess, avoid opening the peritoneal cul-de-sac, for it may be uninfected and still connected with the general peritoneal cavity. In opening a lateral mass, after the vaginal wall is incised the dissection is carried laterally between the layers of the broad ligament. In this way a collection of pus situated even in the upper part of the broad ligament may be drained without opening the peritoneal cavity. The anatomic points to be kept in mind, and also certain details of the operative procedure, are shown in Figs. 874 to 877.

After-treatment.—In the after-treatment of an opened pelvic abscess the two important points are (1) continued free drainage until the cavity has been practically obliterated by granulation, and (2) avoidance of unnecessary irritation, such as repeated packing or probing of the tract, or frequent syringing of the abscess cavity.

Neglect of the first point is the cause of the failure in a large proportion of the cases where the abscess re-forms and requires secondary operation—that is, when the case has been well chosen and is really suitable for vaginal drainage. The neglect of the second point causes much unnecessary pain and irritation by repeated probing and packing of the suppurating tract, and also contributes to failure by early removal of the well-placed rubber drainage tube, which is the only efficient method of continued drainage in this situation.
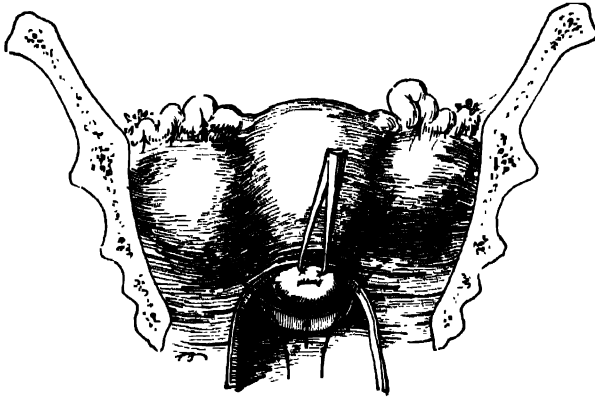
Fig. 875.—Opening a lateral abscess. After the vaginal wall is cut through, the blunt dissection is carried laterally into the broad ligament of the affected side, as indicated by the arrow. In this way opening of the peritoneal cavity may be avoided.

Fig. 876.

Fig. 877.

Fig. 876.—The gloved finger thrust into the opening back of the cervix and directed toward the abscess in the left broad ligament. (Crossen and Crossen—*Operative Gynecology.*)

Fig. 877.—The finger tip appearing in the small abscess cavity high in the broad ligament. Notice the close proximity of the ureter and of the uterine artery. (Crossen and Crossen —*Operative Gynecology.*)

The gauze in the vagina is removed in one or two days and after that an antiseptic vaginal douche is given from one to three times daily, the frequency depending on the amount of discharge. The patient is kept in bed for a week; and after that, if there is no pain or fever, she is allowed to be up and about.

The tube should be left in place as long as there is a cavity to discharge—varying in different cases from two to six weeks. If, after the large tube has been in for a week, the patient complains of pain on bowel movement, or other pain in pelvis, remove the tube and introduce a smaller one.

6. If a **mass of exudate** that may or may not contain pus is found **high** in the pelvis, do not disturb it during the acute attack unless the patient's life is threatened by the severity of the process. Avoid abdominal operation in the primary acute attack, if possible. There are two reasons for this—first, the patient may recover completely under the minor measures and, second, if extirpation of the mass is finally necessary, it can be carried out later with much less danger to the patient. There is less danger later because collections of pus in the pelvis become less virulent after a time. In many old pelvic abscesses the bacteria are dead and the pus is sterile, and extensive contamination of the field of operation fails to cause peritonitis. If, on the other hand, the operation is done early while the bacteria are still virulent, contamination of the field is very likely to result in fatal peritonitis.

In mentioning the fact that the majority of inflammatory masses in the pelvis become sterile after a time, attention must be called to an exceptional class—namely, the streptococcal cases. In the streptococcal masses automatic sterilization or attenuation is uncertain. Though sometimes present, its occurrence can never be counted on. In streptococcal masses the bacteria have been found active and virulent after long periods—even years. Consequently, in these cases intraperitoneal operation is never safe. This point is further considered under Chronic Inflammation.

In these cases of acute or subacute inflammatory mass or infiltration without a distinct pus collection readily accessible from below, the general and special conservative measures are to be persisted in until chance of cure by such means has been eliminated.

7. **High Cellulitis Abscess.**— Occasionally a streptococcal or staphylococcal abscess in the pelvic connective tissue will approach the surface in the lower abdomen, instead of at the vaginal vault. In such a case, if the pus cannot be reached per vaginam, it may be practicable to drain the abscess extraperitoneally by operation above Poupart's ligament. This is entirely practical when the abscess is situated in the broad ligament (as most streptococcal abscesses are) and it has proved a life-saving measure in several instances. The route followed is the same as for ligation of the external iliac artery. In all but exceptional cases, however, an abscess actually in any part of the broad ligament can be reached and drained satisfactorily per vaginam by one experienced in vaginal work.

8. If the inflammation takes the form of a **rapidly spreading peritonitis**, with little or no limiting exudate, or in spite of limiting exudate, it may be necessary to open and drain the peritoneal cavity, by either vaginal section or abdominal section, or both. Such cases are seen principally in pelvic inflammation following labor or miscarriage, and constitute a severe type of puerperal sepsis. The inflammation may have extended directly through the wall of the uterus to the peritoneum, or first to the fallopian tubes and from there to the peritoneum. In either case there is a rapidly spreading peritonitis of virulent type, and the patient is in a desperate condition. There are two methods of dealing with these cases:

Vaginal Section.—Open into the pelvic cavity by posterior vaginal section and let the infected peritoneal fluid run out. Palpate the uterus and appendages, and, if a collection of pus is found, evacuate it. Put in a large size rubber drainage tube and pack the pelvis lightly with gauze, letting the ends extend out into the vagina. The gauze may be removed in a day or two, but the drainage tube should be left in place.

Abdominal Section.—Open the abdomen by incision in the median line and make free drainage with red rubber tubing to the depth of the pelvis, with or without removal of the affected tube or tubes, as seems best in the particular case.

Of the two methods of pelvic drainage, the first (vaginal section) is the preferable one in the majority of cases of acute virulent pelvic peritonitis if the inflammation is still confined to the pelvis. When the general peritoneal cavity is not involved, vaginal section accomplishes all the important results that can be accomplished by abdominal section— the emptying of pus pockets and free drainage of the infected area—and with much less danger to the patient. Of course, if the infection has already extended to the higher portions of the peritoneal cavity, there may be pockets of septic fluid in the central abdomen which cannot be evacuated from below. Under such circumstances abdominal operation is usually required, either alone or in combination with vaginal drainage. In addition to drainage of the infected peritoneal cavity by vaginal section or abdominal section, or both, there are certain other measures of much importance in acute peritonitis—namely, stomach lavage and withholding nourishment by mouth (to prevent injurious intestinal peristalsis), Fowler posture (for drainage), and the introduction of large quantities of normal saline solution into the system (to strengthen the vital organs and aid elimination).

9. **X-ray Treatment.**—X-ray treatment is being employed with good results in an increasing number of types of acute inflammation, and it is worthy of trial in pelvic inflammation.

CHRONIC PELVIC INFLAMMATION

Not all cases of acute pelvic inflammation result in chronic salpingitis, many undergoing curative resolution with only nonsymptomatic sequelae remaining, such as a few adhesions and some old cellular infiltration. This curative resolution without subsequent disturbance may occur in any kind of acute pelvic inflammation but is most frequent in the streptococcal and staphylococcal types which, though more immediately dangerous to life, are more likely to clear entirely if the patient survives. As the infections of this type extend primarily to the pelvic connective tissue instead of the tubes, the persisting lesions, if any, are usually of the broad-ligament rather than the tubal type. Gonococcal inflammation is the type most likely to progress along the mucosa into the tube and to remain there as a chronic salpingitis.

The inflammatory process may be situated principally in the fallopian tubes and pelvic peritoneum, or it may be in the pelvic connective tissue. In chronic pelvic inflammation the different forms of the disease are more distinct than in the acute variety. That is, the cases may be divided into distinct groups, representing different localizations of the inflammatory process and differing considerably in etiology and pathology and symptomatology. It is convenient to divide them into two groups—(a) chronic salpingitis (including complicating oophoritis, pelvic peritonitis, exudate, and adhesions) and (b) chronic pelvic cellulitis (parametritis).

CHRONIC SALPINGITIS

Chronic salpingitis is due to acute salpingitis. In practically every case of genital origin there has been endometritis due to infection following labor, miscarriage, gonorrhea, or instrumentation. From the endometrium the inflammation extends to the tube, causing first acute salpingitis and later chronic salpingitis.

In chronic salpingitis, the serous exudate (whether in the cavity or in the tissues of the tube) has been largely absorbed and the infected areas are surrounded by protective plastic exudate. Any collection of pus is well walled in, and in some cases is sterile from long standing. The adhesions, which at first were simply fibrinous exudate are now organized and contain fibrous tissue and

Fig. 878.

Fig. 879.

Fig. 878.—Chronic salpingitis. Cross-section of tube near outer end. Gyn. Lab.

Fig. 879.—Chronic salpingitis. Cross-section of tube near uterine end. Notice the agglutination of the folds and total disorganization of the tubal interior in this and the preceding specimen. Gyn. Lab.

small vessels. The interior of the tube normally presents the beautiful complex system of mucosal folds with waving cilia on the surface and the functioning cells underneath, as shown in Figs. 99 to 103. In chronic salpingitis the folds become swollen and agglutinated and the interior of the tube becomes disorganized, as shown in Figs. 878 to 880.

The inflammatory round cell infiltration extends throughout the tube wall, and in this chronic stage is characterized by the large number of plasma cells, as shown in Fig. 881, *A*. Plasma cells are distinguished by their eccentric nucleus, as shown in Fig. 881, *B*. They may be further identified by the Unna-Pappenheim stain, which leaves them a bright red.

Types of Lesions

In chronic inflammation of the tube there is found much the same variety of pathologic changes as has been mentioned under Acute Inflammation. However, the serous exudate has been largely absorbed. The adhesions, which at

Fig. 880.—Chronic salpingitis. Low power from the specimen in Fig. 879, showing pus in the tube lumen (at left), marked inflammatory infiltration and destruction of folds. Gyn. Lab.
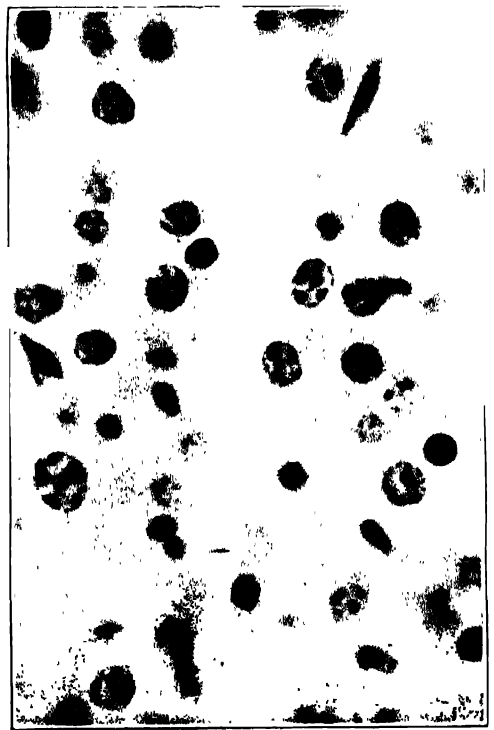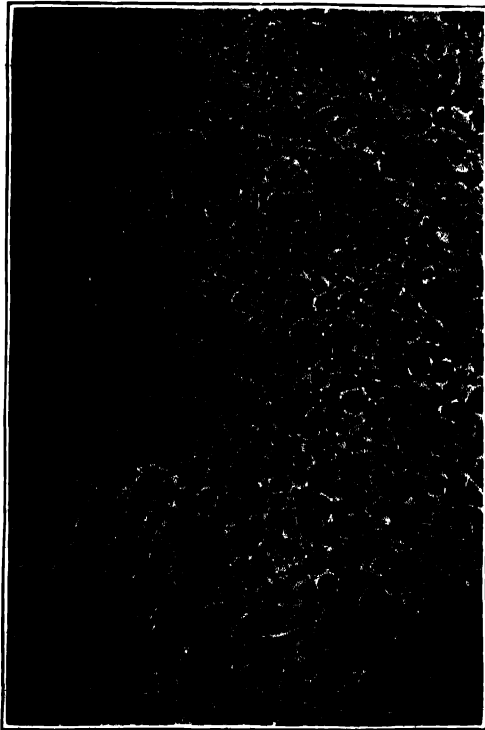
B.

Fig. 881.—*A*, Chronic salpingitis, high power from Fig. 880, showing the cells of the inflammatory infiltration. Most of these are plasma cells. *B*, Chronic salpingitis, very high power from *A*, showing details of the plasma cells, especially the characteristic fragmented nucleus eccentrically placed. Gyn. Lab.

Fig. 882.—Mild salpingitis on the left side. Contrast this with the normal right tube. Notice the enlargement and tortuosity of the affected tube, and also the distortion of the fimbriae.

Fig. 883.—Salpingitis with exudate. On left side is indicated salpingitis with a few adhesions. On right side is indicated salpingitis with extensive exudate and adhesions. The section indicates the relation of the thickened tube, the ovary, and the surrounding exudate.

Fig. 884.—Pyosalpinx. Left tube distended with pus, but with few adhesions. Right tube distended with pus and surrounded by extensive adhesions. The section on the right side indicates the relation of the distended tube to the surrounding structures. The sectioned ovary is indicated dimly below and to the outer side of the enlarged tube, which has fallen behind and to the inner side of it.

first were simply fibrinous exudate, are now organized and some may become stretched into long bands or attenuated cords, owing to the constant movement of the organs. The cases may be divided in classes as follows:

1. **Mild Salpingitis** (Fig. 882).—In the cases of this class the ends of the affected tube are occluded and the fimbriae, matted together and distorted, are frequently adherent to the ovary or some other adjacent organ. The wall of the tube is thickened and the cavity is empty.

Fig. 885.—Pyosalpinx with no adhesions. (Kelly—*Operative Gynecology*.)

Fig. 886.—A very large pyosalpinx, removed intact together with the uterus. The specimen was photographed from the back and shows the ovary and the tortuous appearance of the greatly distended left tube. Gyn. Lab.

2. **Salpingitis With Exudate** (Fig. 883).—In the cases of this class there is a mass of exudate about the tube, binding together the adjacent organs, with more or less damage to the various organs involved.

3. **Pyosalpinx** (Figs. 884 to 888).—The occluded tube contains a collection of pus. There may or may not be extensive exudate and adhesions. There is no pus outside the tube.

These tubes may gradually enlarge until of great size (Figs. 886, 887), or the inflammation may break through and cause extensive peritubal adhesions, as shown in Figs. 884 and 888. The affected tubes are usually thick-walled and contain pus (Fig. 887), which may be still infective or may be sterile. Ordinarily in these closed cavities gonococci are automatically killed

Fig. 887.— Section through a pyosalpinx, contrasting the fairly normal uterine end of the tube (to the left) with the distended portion. The pus in the tube has been hardened by preservation of the specimen in formalin. Gyn. Lab.

Fig. 888.—Pyosalpinx with very extensive adhesions. (Kelly—*Operative Gynecology.*)

by their own products in three or four months. The large sterile tubal abscess remains as a foreign body, causing persistent or recurring disability. Not infrequently there is secondary infection by colon bacilli or other bacteria, coming in from adjacent organs or by the blood stream.

4. **Ovarian Abscess.**—The inflammation may extend to the ovary, forming an ovarian abscess in connection with a tubal abscess, as indicated in Fig. 889,

right side of pelvis. More rarely there is a distinct ovarian abscess without evident pus formation in the tube, as indicated on left side of pelvis.

5. **Diffuse Pelvic Suppuration** (Fig. 890).—In the cases of this class the pus has extended outside the tube. As the pus extends in various directions,

Fig. 889.—Ovarian abscess. A window, cut in the wall of the abscess on the right side, shows that it is composed of a tubal portion and an ovarian portion (tuboovarian abscess), with a communication between the two cavities. On the left side is indicated an abscess involving the ovary only, which is a much rarer condition.
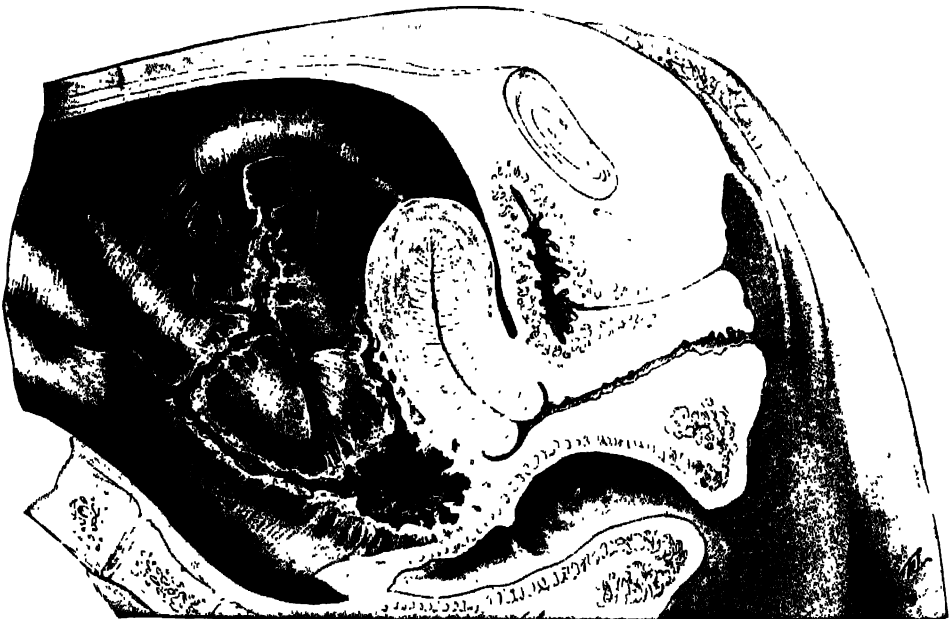
Fig. 890.—Diffuse pelvic suppuration from pyosalpinx. The pus has broken through the tube wall, spread among the intestinal coils and gravitated to the cul-de-sac. A window, cut in the distended tube, shows the connection of the suppurating tract with the tubal cavity.

the exudate extends in front of it, shutting it off from the general peritoneal cavity. As in acute inflammation, this process may extend until all the pelvic organs are bound together in an irregular mass, with pus lying in the spaces between them.

6. **Hydrosalpinx** (Fig. 891).—The tube may be much distended and contain serous fluid, but no pus. As the result of the pressure of the fluid within the closed tube the largest part of the mucous lining is destroyed. Only here

Fig. 891.—Double hydrosalpinx. The sectioned right tube indicates clearly the marked thinning of the wall found in these cases.
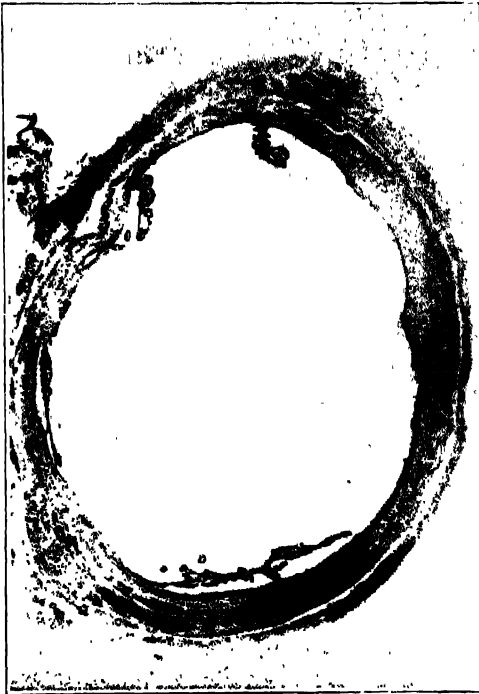
Fig. 892.

Fig. 893.

Fig. 892.—Hydrosalpinx. Notice how the pressure of the fluid destroys the mucosal folds, leaving only a few remnants.

Fig. 893.—This shows, under higher power, the small fold-remnant at the top in Fig. 892. Gyn. Lab.

and there a preserved typical fold can be seen. There may or may not be many adhesions. This condition is designated hydrosalpinx, and is usually the result of a very low-grade infection. The fimbriae in the chronic pus tubes

and in hydrosalpinx are usually found adherent, retracted toward the lumen. This is due to the fact that the fimbriae are merely continuations of the mucous lining of the tube, and with the chronic inflammation and resulting fibrous contraction, are drawn in mechanically. These tubes are often bound in the cul-de-sac by adhesions.
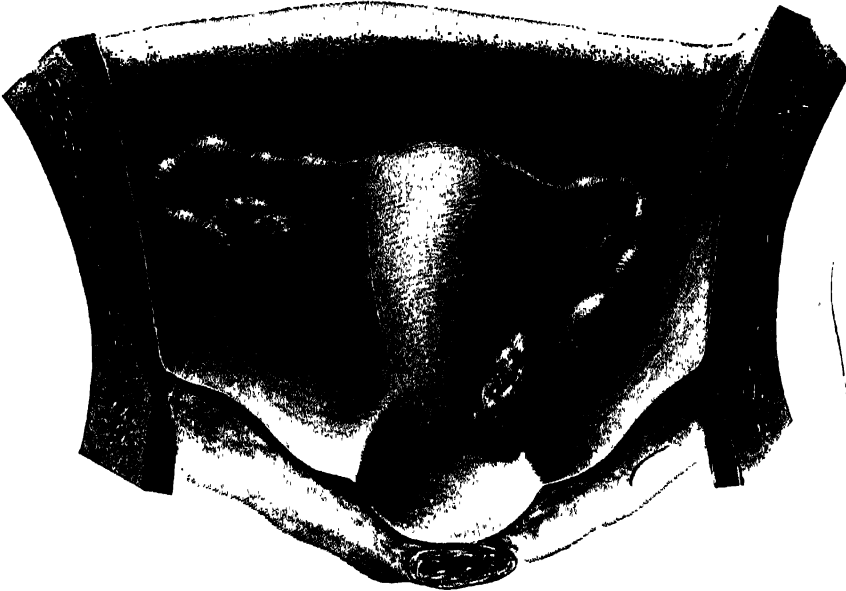
Fig. 894 —Nodular salpingitis. This form of chronic salpingitis is usually bilateral, and is often accompanied by prolapse of the tube or ovary on one or both sides.

A.   B.
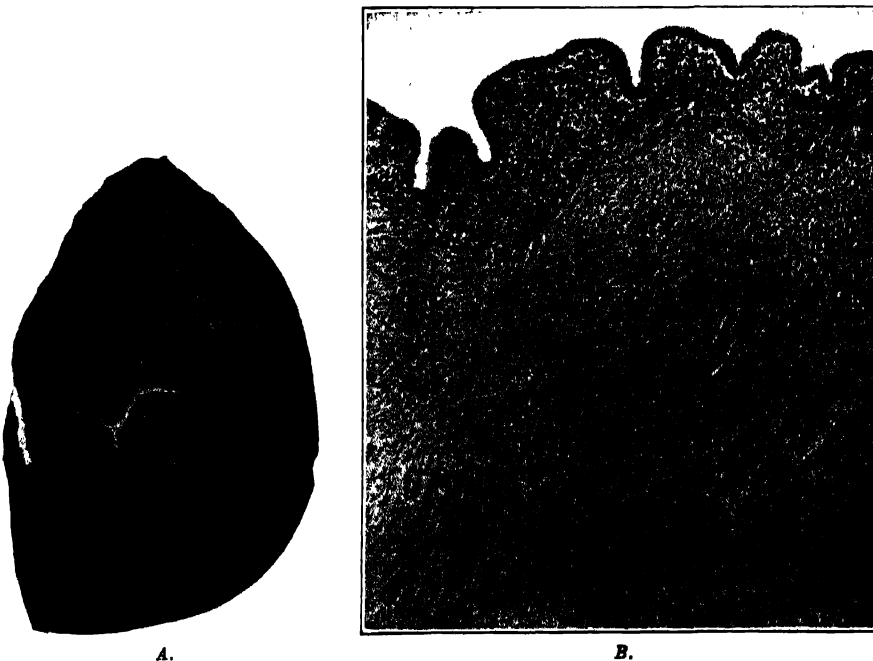
Fig. 895.—Nodular salpingitis, cross-section. A, Shows a markedly thickened tube. The thickness is due entirely to chronic inflammation and fibrous tissue formation in the wall. The lining epithelium is intact—see B. B, High power of A. Notice inflammatory infiltration of the wall and the intact epithelial lining of the cavity. Gyn. Lab.

The distention of the tube tends to flatten out the folds till only remnants remain, as shown in the photomicrographs in Figs. 892 and 893.

7. **Nodular Salpingitis.**—The wall of the tube becomes greatly thickened, the thickening being so irregular as to give the tube a distinctly nodular appearance, as indicated in Fig. 894. Usually both tubes are affected, and frequently there is also chronic oophoritis of one or both sides. The microscopic picture is shown in Fig. 895.

8. **Adhesions.**—There is a class of cases of chronic salpingitis in which the tubal trouble is slight or has largely disappeared, but the resulting peritoneal adhesions are extensive and troublesome, dislocating the tubes and ovaries and holding them firmly in abnormal positions. In such cases all active infection may have disappeared, leaving only the sequelae, consisting of exudate, adhesions, and distortions, as indicated in Fig. 896.

Fig. 896.—Multiple adhesions from chronic pelvic inflammation. This illustration represents a posterior view of the pelvic organs, with the intestinal coils pushed upward and to the sides to show the numerous adhesions.

Symptoms

The symptoms of which the patient complains in chronic salpingitis are **backache** and **pain in the pelvis,** increased by walking or working. There is **tenderness** in the lower abdomen, usually over one or both tubes. There are decided **menstrual disturbances,** consisting of painful menstruation, prolonged menstruation, and an increase of all the troublesome symptoms at the menstrual periods. The patient complains of **weakness** and loss of weight, and an inability to stand walking or working as she formerly did. **Vaginal discharge** is usually present, due to the accompanying endometritis. There occur also **exacerbations,** in which the patient has sharp pain and some fever, and is sick in bed from a few days to several weeks.

On examination there is found **tenderness** in the tubal region of one or both sides and in most cases **a mass** in the same region. If the inflammation

is slight, there may be no mass of exudate, but simply a thickening of the affected tube. If the inflammation is more marked, there is a distinct mass beside the uterus in the tubal region, fixing the uterus to the pelvic wall. If the inflammation is still more marked, the posterior cul-de-sac contains a mass of exudate, or the whole pelvis may be filled with a mass, which forms a wall above the plane of the vagina (Fig. 866), and the uterus is fixed immovably in this roof of exudate. The exudate is tender when pressed upon and, if there is a large **collection of pus,** fluctuation may be felt in the cul-de-sac of Douglas or in the tubal region of one side. The uterus is fixed, and attempts to move it cause pain. The amount of **fixation** or limitation of movement depends, of course, on the extent of the exudate and adhesions.

The cases of chronic salpingitis frequently present also complications—laceration of pelvic floor, laceration of cervix, retroversion of uterus, and chronic endometritis. These conditions should be searched for and noted, for they must be taken into consideration in the treatment.

Diagnosis

The diseases which may be confounded with chronic salpingitis, and which therefore must be taken into consideration in the differential diagnosis, are as follows:

> Chronic endometritis.
> Myoma of the uterus.
> Pelvic endometriosis.
> Tubal pregnancy, with chronic symptoms.
> Tuberculosis of the tubes and peritoneum.
> Ovarian and broad ligament tumors.
> Chronic appendicitis.
> Mucous colitis.
> Bladder and rectal affections.
> Pelvic neuralgia.

In **chronic endometritis,** without pelvic inflammation, the trouble is confined to the uterus, and consequently there is no marked tenderness nor any inflammatory mass outside the uterus.

In **myoma** of the uterus usually the symptoms are of gradual onset, and consist principally of menstrual disturbances, particularly increased flow. There is absence of fever and absence of attacks of pelvic peritonitis. The mass is firm, has a definite and rounded outline, is intimately connected with the uterus and there is not the marked tenderness that is found in pelvic inflammation. There is no fixation unless the tumor is large enough to impinge on the pelvic wall. The uterus and tumor are movable together, but not separately.

Pelvic endometriosis is a condition often so difficult to differentiate from chronic inflammation that it is well to consult the detailed consideration of symptoms given under that disease.

Tubal pregnancy, with chronic symptoms, is a serious condition which has often escaped recognition, because the atypical accompaniments of the supposed chronic inflammation were not analyzed. These are given detailed consideration under Tubal Pregnancy.

Tuberculosis of tubes and peritoneum should be suspected when there are decided symptoms of pelvic inflammation in a young woman who has had no opportunity to contract pelvic inflammation—that is, in a woman who has never had endometritis. There is gradual onset, usually, and persistent progress without the marked improvement usually

following the treatment of ordinary pelvic inflammation. There may be encysted ascites—a collection of fluid shut off from the general peritoneal cavity by adhesions—without the marked pain and fever that would come with a collection of pus. Other points are evidence of tuberculosis elsewhere, and emaciation, gradual but marked and persistent, and more than accounted for by the small amount of pain and fever.

Ovarian and **Broad Ligament Tumors** present a gradual onset of symptoms. There is absence of fever and of marked menstrual disturbance and of severe attacks of pelvic peritonitis. There is usually a definite tumor mass without particular tenderness and without fixation. In the case of an ovarian tumor the mass can usually be moved about in the lower abdomen. There may be distinct fluctuation without marked tenderness, indicating that the fluid is not pus.
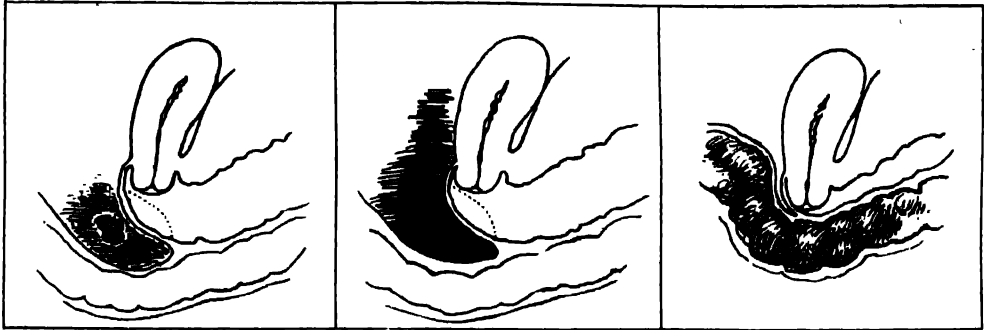
Fig. 897.   Fig. 898.   Fig. 899.

Figs. 897 to 899.—Differential diagnosis of pelvic inflammation. A mass low behind cervix. Fig. 897, Inflammatory mass filling cul-de-sac. Fig. 898, Blood filling cul-de-sac. Fig. 899, Fecal mass distending rectum back of cervix.
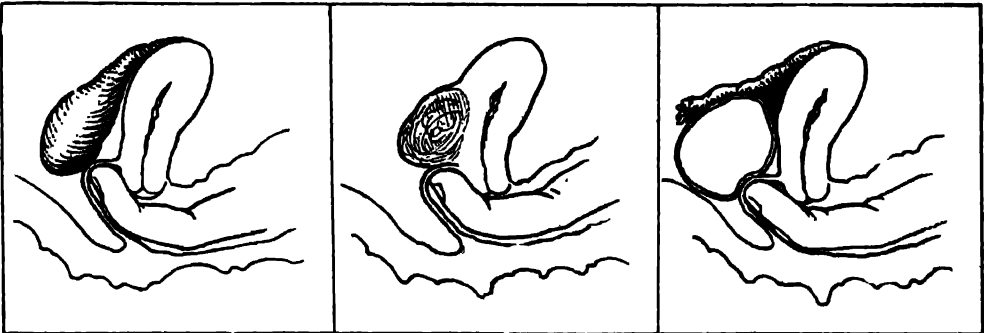
Fig. 900.   Fig. 901.   Fig. 902.

Figs. 900 to 902.—Differential diagnosis of pelvic inflammation. A rounded mass rather high in cul-de-sac. Fig. 900, Tubal mass. Fig. 901, Small myoma on posterior wall of uterus. Fig. 902, Small ovarian cyst.

Chronic Appendicitis may be difficult to differentiate from chronic salpingitis of the right side. The facts pointing to appendicitis are as follows:

a. High location of the painful area, at McBurney's point, without a painful area at the site of the fallopian tube.

b. Stomach and intestinal disturbance, preceding and accompanying an attack. Also pain in the region of the umbilicus, rather than in the back.

c. High location of the mass of exudate—not felt so well from vagina as would be a mass about the fallopian tube.

d. Absence of endometritis and absence of a history of previous uterine sepsis or gonorrhea.

e. No marked increase of the trouble at the menstrual periods. Even appendicitis may show some increase then, but it is not so marked as in salpingitis.

In a case of inflammation in the right lower abdomen in a girl, or in a woman who has never been pregnant nor had any uterine infection, the trouble is more likely to be appendicitis. On the other hand, in a case of inflammation in that locality in a woman who has once had infection of the uterus, the probability is in favor of salpingitis. In some cases it is impossible to make a positive differential diagnosis until the abdomen is opened. In fact, it not infrequently happens that both structures are involved in the inflammatory process, the inflammation beginning in the tube and extending to the appendix or beginning in the appendix and extending to the tube.

Other **intestinal diseases** also must be excluded. Mucous colitis is the one which has most frequently been mistaken for chronic tubal or ovarian inflammation. The points that distinguish mucous colitis from chronic pelvic inflammation are (a) the character of the pain (resembling intestinal cramps and extending throughout the lower abdomen), (b) the passage of characteristic masses of mucus during some of the attacks, and (c) the absence of any palpable pelvic lesion.

There are also diseases of the **urinary organs** that may be confounded with chronic pelvic inflammation. All these affections must be excluded by a knowledge of the symptoms and signs that accompany them.
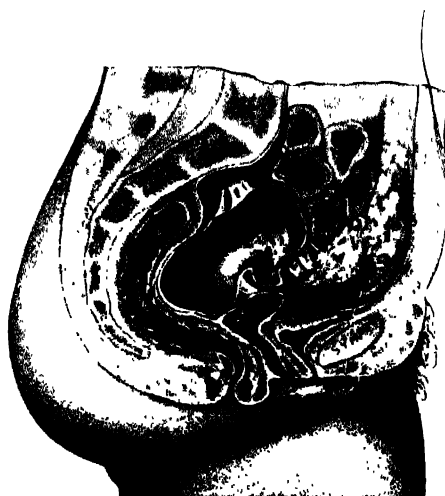
Fig. 903.   Fig. 904.

Fig. 903.—Thickened tube and ovary prolapsed into the cul-de-sac behind the uterus. (Montgomery—*Practical Gynecology*, The Blakiston Company.)

Fig. 904.—An abscess behind the uterus. (Montgomery—*Practical Gynecology*.)

In **pelvic neuralgia** and in neurasthenia, and in hysteria, without complicating pelvic inflammation, there is no abnormal mass within the pelvis. In pelvic neuralgia the tenderness may be localized along the pelvic nerve trunks (see Fig. 244). Certain conditions in the posterior cul-de-sac area that must be differentiated in examination are indicated in Figs. 897 to 904. Masses occurring in the broad ligament area are indicated in Figs. 905 to 908.

Treatment

In the treatment of chronic salpingo-oophoritis, there are certain general measures, which are applicable to practically all cases, and there are also special measures which are applicable to special conditions only.

General Measures

1. Attention to the general health is important. This includes diminution of work and family care to the point where it is not exhausting, regular sleep, periods of rest (especially at the menstrual time), proper nourishment, elimination, blood making, and special medication needed for any special conditions.

2. Vaginal douches, as needed to take care of any irritating vaginal discharge. These may be the ordinary vaginal douche or the long hot douche, as preferred.

3. Office treatments, for anything which may be improved thereby, and also for observation as to progress under the measures being employed.

Special Measures

1. Correction of **local complications** is important. Such associated condition may be a factor in prolonging the trouble, such for example as chronic cervicitis or chronic endometritis persisting from the inflammation which extended to the tubes. In such a case, troublesome chronic salpingitis may sometimes be decidedly benefited by removal of the cervix infection by conization and improvement of intrauterine condition by curettage.

2. Heat treatment in the form of the electric baker may be employed with benefit in case of exacerbation with acute or subacute symptoms. Also, in some cases a course of chemotherapy in the form of sulfanilamide medication may be beneficial.

3. If there is a collection of pus low in the pelvis, it should be **opened and drained** by vaginal operation, according to the technique given in detail under Acute Pelvic Inflammation (Figs. 868 to 871). In the after-treatment, the drainage tube will have to remain in longer than for an acute abscess of the same size, for the chronic abscesses have thicker walls and hence collapse more slowly.

4. If there is an inflammatory **mass high,** which probably contains pus or which continues to give serious trouble after a thorough trial of the general measures, abdominal operation for the removal of the mass may be necessary.

In this connection it is important to differentiate between tubal masses and inflammatory masses in the connective tissue (cellulitis, parametritis). In the latter, abdominal operation is definitely contraindicated for two reasons. Such masses, being in the connective tissue, cannot be extirpated as can a salpingo-ovarian mass. Again, they are usually due to streptococci, which may be still virulent, and hence if the mass is disturbed at all it should be by vaginal drainage, to avoid peritoneal contamination.

5. Avoid Radical Operation in those cases in which the examination shows only a somewhat thickened and tender tube (catarrhal salpingitis), or a slightly enlarged and sensitive and perhaps prolapsed ovary (cystic ovary), or adhesions with some induration and fixation, but with no distinct mass. Give a thorough trial of the nonoperative measures previously mentioned, with such additions and modifications as the peculiarities of the case may suggest. Some such cases may be benefited by the special application of deep heat, such as diathermy with its localization of maximum heat to the deep area affected, or the Elliott treatment with its general diffusion of heat throughout the pelvis.

Careful study should be made of the patient generally—of all the organs. In some such cases it will be found that the principal trouble is some general disease or some local disease in another portion of the body, the pelvic disorder being of secondary importance. If nothing is found outside the pelvis

to account for the patient's symptoms and all other measures fail to relieve the pelvic distress, operation is to be considered.

6. In the operative cases, when the patient is under thirty-five years of age and the pathologic condition will permit, it is advisable to **preserve enough ovarian** tissue to continue menstruation and enough fallopian tube to make pregnancy possible, if the organs do not seem seriously involved in the inflammatory process.

Preservation of an organ which is the seat of active chronic inflammation may necessitate another serious operation at a later date, but in those cases in which all active inflammation has disappeared, leaving only adhesions and exudate, it is often possible to preserve in place part of an ovary and part of a tube, which by proper treatment may continue their functions. Even if pregnancy does not take place, the simple fact that it may take place—that it is possible—leaves the patient in a much better frame of mind.

If the uterus must be removed, one ovary at least should be preserved, if it is not diseased, because the preservation of one ovary, or even part of an ovary, tends to prevent those troublesome nervous symptoms which frequently accompany the artificial menopause and which sometimes become serious.

CHRONIC PELVIC CELLULITIS (PARAMETRITIS)

Parametritis is chronic inflammation of the connective tissue surrounding the uterus, being synonymous with cellulitis. There is usually more or less secondary infiltration of the connective tissue in all extensive pelvic inflammations, and sometimes pus of tubal origin will make its way into the connective tissue. Most of the cases of well-marked cellulitis, however, are due to extension of infection directly from the uterus into this region.

Etiology

Chronic cellulitis is due to a preceding acute cellulitis and consequently has the same causative factors. It is usually due to infection following labor or miscarriage, the bacteria passing directly through the wall of the uterus into the connective tissue or through tears of the cervix. In other cases it can be traced to operation on the cervix, to operation within the uterus, to instrumental examination of the interior of the uterus, or to attempts at abortion. Cellulitis alone (without tubal involvement) is usually due to the streptococcus, staphylococcus, or colon bacillus—practically never to the gonococcus. This point is further discussed under differential diagnosis and selective treatment.

Pathology

Pelvic cellulitis, like inflammation of connective tissue elsewhere, is essentially an acute or subacute lymphangitis, running its course and ending in resolution or abscess formation, or a mass of unabsorbed exudate and infiltration, which may or may not conceal a focus of pus in its interior. Occasionally the infection will progress through the wall of the uterus as a thrombophlebitis and later break through the broad ligament veins into the connective tissue. The condition in any particular case may vary from a small

area of induration on one side of the cervix to extensive induration, involving the connective tissue all around the uterus and extending out to the pelvic wall on each side. The process may extend forward into the connective tissue beside the bladder, or backward along the sacro-uterine ligaments.

Symptoms and Diagnosis

The **symptoms** are much the same as those due to salpingitis—namely, backache, pain in the lower abdomen, tenderness in pelvis, and menstrual disturbances. The severe exacerbations, so characteristic of salpingitis, are not
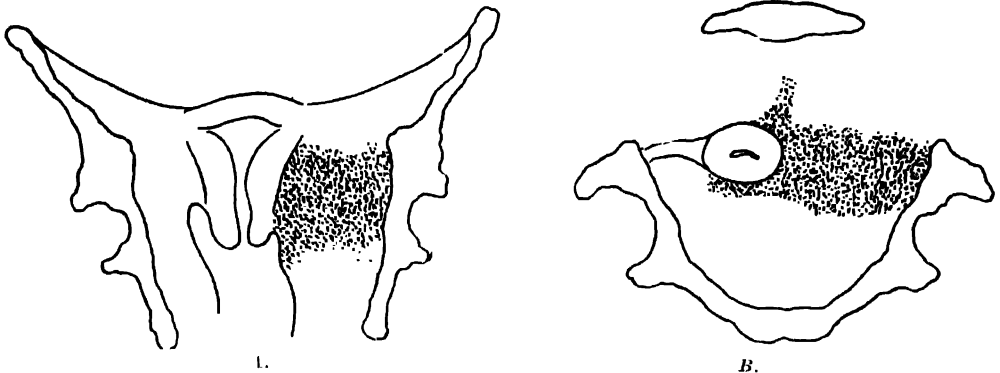
Fig. 905.—Diagnosis of chronic parametritis (pelvic cellulitis). There is firm infiltration in the broad ligament of one or both sides. Notice how the outline of the firm infiltration follows the outline of the connective tissue area. *A,* Vertical side-to-side section. *B,* Transverse section.
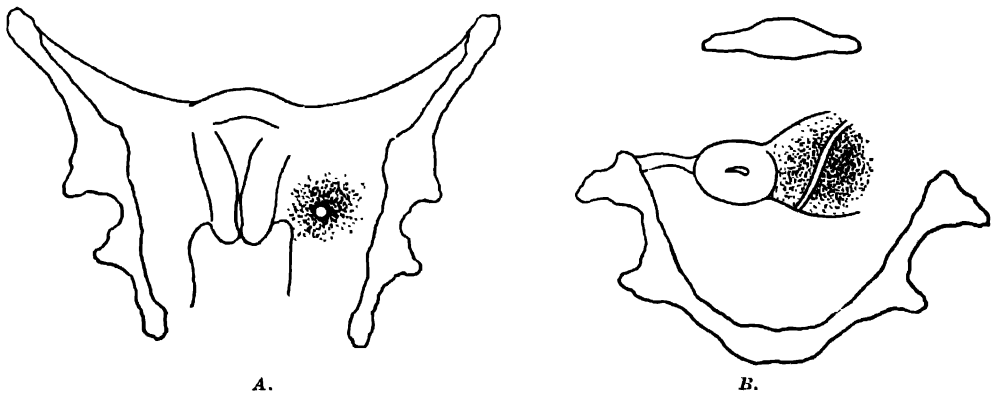
Fig. 906.—Diagnosis of periureteritis. The limited infiltration is in the region of the ureter. Also, there are usually accompanying symptoms indicating cystitis or ureteritis.

present usually in cellulitis, unless there is complicating salpingitis. Often the principal complaint is dyspareunia, the pain in coitus being due to the fact that movement of the cervix causes pain from the adjacent connective-tissue inflammation.

On examination, **induration of extreme hardness** is felt very low in the pelvis and closely attached to the sides of the cervix—the portion of the uterus in contact with the connective tissue (Fig. 905). The marked induration may extend out to the pelvic wall, and may be so intimately attached to the bone and so hard as to appear to be a bony or cartilaginous outgrowth

from the wall of the pelvis. Parametritis (of uterine origin) is to be distinguished from another inflammatory mass in this locality, namely, ureteritis and periureteritis (Fig. 906). As the location and tenderness are the same, the distinction is made by the accompanying history and symptoms.

An intraligamentary myoma (Fig. 907) is distinguished by the rounded outline, its broad uterine connection and free outer margin, the absence of tenderness, and the accompanying history and symptoms. A parovarian cyst has the additional distinguishing point of being soft, and there may be distinct fluctuation.

A.   *B*
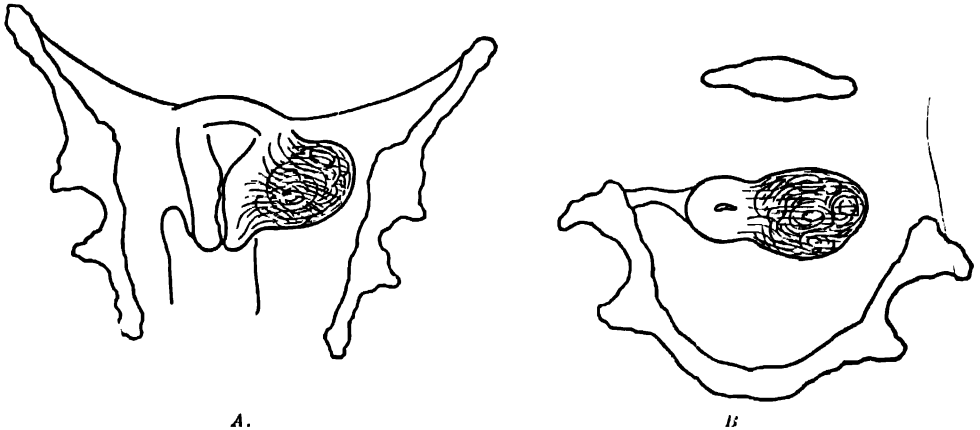
Fig. 907.—Diagnosis of uterine myoma projecting into the broad ligament. Notice the distinct clear-cut outline some distance from the pelvic wall, which outline can be traced directly into the outline of the uterus. In a parametritis mass of that size the inflammatory infiltration would extend to the pelvic wall, giving fixation of the mass to the wall, and the margins of the infiltration would shade off gradually.

A.   *B.*
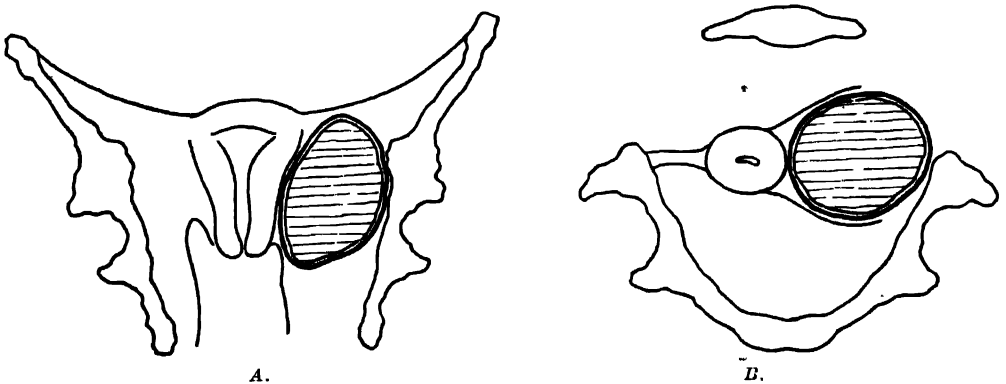
Fig. 908.—Diagnosis of a broad ligament cyst. This presents the clear-cut margins of a tumor, to distinguish it from inflammatory infiltration, and presents cystic fluctuation or softening to distinguish it from a myoma.

In some cases the chronic inflammatory mass involves both the tubal area and the connective tissue area. When such is the case and it is difficult to determine whether the primary lesion was parametritis or salpingitis, the history of the trouble (cause and subsequent course) may help. The differentiation between parametritis and salpingitis is very important in all cases, for the type of treatment to be employed hinges upon it. A broad ligament mass is likely

to be streptococcic, and may still contain viable streptococci that could cause fatal peritonitis if the mass were attacked and opened into by intraperitoneal operation.

Differential Diagnosis and Selective Treatment of Chronic Pelvic Inflammatory Masses

The importance of postponing operation in gonococcal masses until automatic sterilization has taken place, the persistence of virulence in streptococcal masses and how to recognize them before operation and what to do for them when operation is necessary, and other points of interest were considered in detail in a published study of this subject by the senior author (What Is the Preferable Time for Operation for a Chronic Inflammatory Mass in the Pelvis?), and the following summary is largely from that study.

1. Bacteriologic studies in the several reported series of cases (comprising about 3,600 cases) of chronic pelvic inflammation (excluding tuberculosis) showed that the tubal contents were sterile in more than half. This indicates that sterilization of the infected focus takes place automatically within a reasonable time in the majority of cases.

2. Abdominal removal of the mass while the bacteria are active and virulent results in fatal peritonitis or localized infection in many of the cases. Abdominal removal of the mass after the bacteria are dead or greatly attenuated is almost never followed by infection, even though there is extensive escape of pus into the pelvis. Hence abdominal operation for a chronic inflammatory mass in the pelvis should not be undertaken before the period of probable sterilization, except in those rare cases in which, in spite of palliative measures, the patient's life is threatened by the severity of the inflammation and the infected focus cannot be satisfactorily drained extraperitoneally.

3. The time required for the death of the bacteria or for their effective attenuation varies greatly in different cases. The persistence of virulence depends largely upon the character of the infection. The two infections concerning which definite information has accumulated as to persistence of virulence are the gonococcal and the streptococcal.

In the gonococcal cases the bacteria are dead or attenuated to practical sterility within three or four months from the beginning of the trouble. In such cases abdominal section may be safely undertaken after this period. In the streptococcal cases, on the other hand, the bacteria live and retain their virulence indefinitely. In some cases there seems to be a diminution in the virulence, but this is erratic and not to be depended upon. Abdominal section for a mass of streptococcic origin is never safe. Such an operation at any time, even years after the infection, is liable to be followed by fatal peritonitis.

4. These two classes may be distinguished before operation in most cases, the distinguishing characteristics of each being found in the **apparent cause** of the trouble and the **location of the lesion.**

Classification. For the purpose, then, of considering the persistence of virulence in a practical way, i.e., as a guide to treatment, the cases of chronic pelvic suppuration (tuberculosis excluded) may be divided into two classes—the gonococcic and the streptococcic. To be useful, this classification must be made before operation, that is, it must be a clinical rather than a strictly bacteriological classification. Of course, from a bac-

teriologic standpoint there are other cases, due to other bacteria, but in the present state of knowledge these other cases cannot, as a rule, be distinguished before operation, and, even if they were distinguished, not enough information has accumulated to show the average persistence of virulence in such cases. Consequently, when confronted with a case of nontuberculous chronic pelvic inflammation, the endeavor should be to decide whether it belongs to the gonococcic or streptococcic class, ignoring for the time the fact that it may possibly be due to other bacteria, which in point of virulence lie between these two extremes.

How may the gonococcic and the streptococcic cases be distinguished before operation? What diagnostic facts are available at that time? Bacteriologic examination of the urethral or uterine or other discharge is of assistance in only a small proportion of these chronic cases, for, as a rule, the bacteria have disappeared from the discharge. Hence we must depend on other information obtainable before operation. Fortunately the gonorrheal cases and the streptococcal cases differ usually in two particulars, namely, (a) in the apparent cause of the trouble, and (b) in the location of the lesion. As a rule, these distinguishing points may be settled and the case definitely classified by an accurate inquiry into the onset of the trouble and a careful bimanual examination.

Uncertain cases are to be classed with one or the other, as the preponderance of evidence warrants, and are to be given treatment accordingly. After operation, bacteriologic examination may show other bacteria, either alone or associated, and, if accurate records are kept of the histories and bacteriologic findings in large series of cases, it may be possible later to form a third clinical class, comprising one or more of the miscellaneous or mixed infections. For the present, however, the two classes, gonococcic and streptococcic, are all that can, as a rule, be satisfactorily distinguished before operation.

GONOCOCCIC CLASS (CLINICAL)

In the gonococcic class (clinical) the distinguishing points are (a) that the pelvic inflammation is preceded by evidence of gonorrhea or comes on without apparent cause and (b) that the lesion is located in the tube, as indicated in Fig. 863, extending thence to the ovary or adjacent peritoneal surfaces but not involving the connective tissue (parametrium) to any decided extent. As so much diagnostic importance is attached to these two points, it is necessary to consider them somewhat in detail.

a. Apparent cause or mode of onset. As a general proposition it may be said that the gonococcus is the only germ that will spontaneously invade the normal nonpuerperal uterus and tubes. There are exceptions. Reidel reported that of 56 girls under ten years of age operated on for appendicitis, five had peritonitis due, not to appendicitis, but to acute salpingitis. He states positively that the infections reached the tubes by way of the vagina and uterus, and that gonorrhea was excluded in every case. Cultures showed the ordinary pus germs. The inflammation was virulent and every patient died in spite of operative treatment. He observed the same clinical picture in two girls past ten years of age, both of whom died. In contradistinction to these cases in children, he states that he has never seen such penetration of normal genitalia by streptococci or staphylococci in the adult.

General experience is in accord with this statement in regard to adults. Purulent inflammation beginning in a normal adult nonpuerperal vagina or uterus, and later extending out into the pelvic cavity, may be set down as almost certainly gonorrheal. The patient must of course be questioned closely enough to eliminate an early miscarriage and also any intrauterine instrumentation (curettement, intrauterine treatment, sounding in examination, etc.). The probability of gonorrhea is increased if the purulent discharge ("free leucorrhea") began within a few weeks after marriage. Again, in a large proportion of the cases of gonococcal leucorrhea there is urethritis, causing burning on urination and increased frequency of urination. This discharge and disturbance of micturition may last a few days or much longer. It may precede the pelvic inflammation by a few days or a few weeks or a few months. A history of abscess of one of the vulvovaginal glands has about the same significance as a history of urethritis. These structures are frequently involved in gonococcal leucorrhea, but very seldom in leucorrhea from other causes.

In those cases in which the vaginal and uterine gonorrhea did not cause sufficient disturbance to be noticed, the pelvic inflammation began without apparent cause. A con-

siderable proportion of the gonorrheal cases give such a history. Here, again, one must be careful not to overlook an early miscarriage or some intrauterine instrumentation. Also, it is important to trace the inflammation back to its very beginning, for some cases of puerperal infection are very mild in outward manifestations and do not cause much trouble until there is an exacerbation after several weeks or months. In these cases, however, there is usually a history of some disturbance during the puerperium, from which the patient recovered to a large extent, but not entirely. On the other hand, an inflammatory trouble, at first apparently due to a miscarriage or full-term delivery, may on careful questioning be found to antedate the pregnancy and to be due to a preceding gonorrheal infection.

In the examination a search should be made about the external genitals for evidences of an old gonorrhea—signs of previous inflammation of the urethra or of the vulvovaginal glands, such as red spots (maculæ gonorrhœa) in these situations, or secretion that can be pressed from the structures. Bacteriologic examination of discharge from the urethra, vulvovaginal glands, vagina, or cervix may show gonococci. Negative findings, however, do not exclude gonorrhea, for in many of the chronic cases the causative bacteria have disappeared from the discharge.

b. **Location** of the lesion. The extension of gonorrheal inflammation is almost invariably along the uterine mucosa into the tube, and any further extension is toward the ovary and the peritoneal cavity. Gonococci very seldom extend through the uterine wall into the parametrium. Even when they do extend into the connective tissue, they are not likely to form an inflammatory mass there. Steinschneider and Schaefer injected pure cultures of gonococci into connective tissue, but no decided inflammatory action resulted. Though parametrial abscess may occasionally result from gonococci, as demonstrated by Wertheim and others, it is so rare as to be a curiosity.

STREPTOCOCCIC CLASS (CLINICAL)

The distinguishing characteristics are (a) the apparent cause of the trouble and (b) the location of the lesion. The inflammatory lesion is located in the parametrium, either in the connective tissue as in Fig. 864 or in the veins as in Fig. 865.

a. **Apparent cause.** Nearly all the streptococcic inflammatory masses in the pelvis can be traced to sepsis following labor or miscarriage. In the adult, streptococci do not spontaneously penetrate the nonpuerperal uterus. Aside from labor or miscarriage, streptococcus infection may be due to curettement or other uterine operation, to intrauterine application or sounding, to a stem pessary, or to conditions caused by carcinoma or fibroid or chronic inflammation. If a pelvic inflammatory trouble cannot be traced to one of the causes above mentioned, it is almost certainly not streptococcic. In taking the history, care must be exercised not to miss an early miscarriage or an intrauterine treatment. Care must be taken also to trace the trouble back to its very beginning, otherwise an exacerbation remote from the causal miscarriage or labor may be mistaken for the beginning of the trouble.

On the other hand, not all puerperal cases are streptococcic. About twenty-five per cent of puerperal infections are gonococcal. They are usually of a mild type and subside quickly, but it must be kept in mind also that other puerperal infections (staphylococcic and even streptococcic) may run a mild course. Consequently the mildness of the preceding septic attack must not be given too much weight. Outside of external evidences of gonorrhea (about the vulva or in the discharge), most dependence is to be placed on the location of the lesion. Streptococcus lesions are usually parametrial, while gonococcus lesions are usually tubo-ovarian.

Another complicating factor in these puerperal cases is that there may be a mixed infection, causing both kinds of lesions to be present. Stone and McDonald reported such a case. This case furnished also a beautiful and striking illustration of the fact that the gonococcus spreads by way of the mucous membrane and the streptococcus by way of the connective tissue. The gonococci occupied the right tube and extended thence into the peritoneal cavity, while the streptococci occupied the right broad ligament and extended thence into the peritoneal cavity.

b. **Location** of the lesion. A chronic lesion in the pelvis of streptococcic origin is nearly always in the connective tissue (parametrium). Unlike the gonococcus, the strepto-

coccus does not progress along the mucosa into the tube, but penetrates the wall of the uterus and extends into the connective tissue. It not infrequently extends from the connective tissue to the peritoneum, causing peritonitis. Of course, in exceptional cases streptococci may pass from the uterus into the tube, but in such cases they are likely to pass on through the tube and cause fatal peritonitis. Consequently, in the streptococcic cases that survive the acute attack and come later for treatment for an inflammatory mass, the lesion nearly always involves the connective tissue (parametrium). As before mentioned, Menge found the streptococcus in four cases of pyosalpinx, while Whiteside and Walton found it in three, but parametritis was not excluded. The last mentioned authors endeavored to produce streptococcus salpingitis experimentally by injecting into the uterus in rabbits pure cultures of streptococci and also mixed cultures of streptococci and staphylococci. In no instance did salpingitis result. One rabbit died of acute streptococcus septicemia, while the others simply developed a purulent vaginitis for a few days and then recovered, and when replaced in the rabbit pen became pregnant and bore litters of six rabbits each. Miller, in the bacteriological examination of 127 cases of pelvic inflammation, found the streptococcus 7 times, but in no case was the lesion a pyosalpinx alone. There are very few exceptions to the rule that streptococcal masses in the pelvis are parametrial in whole or in part.

Are all parametrial inflammatory masses streptococcic? Nearly all. That parametrial suppuration is usually due to the streptococcus is substantiated by Rosthorn, Bumm, Doleris and Bourges, West, Cullingworth, and others. Hartman and Morax found it in 21 cases of parametrial abscess. In every such case operated on by Fritsch the streptococcus was found to be the cause. It is only occasionally that staphylococci and other bacteria are found either alone or associated with the streptococcus. As parametrial inflammation is nearly always due to the streptococcus, every case presenting a parametrial mass should be placed in the streptococcic class until it is definitely proved to be due to some other cause.

The distinguishing characteristics of a parametrial mass (chronic) are: (a) its situation in the connective area, usually in the broad ligament; (b) its low situation in relation to the uterus, often coming far down beside the cervix; (c) its intimate blending with the uterine wall, as though it were a part of the wall; (d) its intimate blending with the pelvic wall, as though it were an outgrowth from that structure; and (e) its hardness, often being so hard as to simulate a cartilaginous or bony tumor growing from the pelvic wall. A tubo-ovarian mass, on the other hand, is distinguished by its being situated high, in the tubo-ovarian region, or prolapsed into the cul-de-sac; by its not blending so intimately with the uterine wall, a distinct groove usually marking the point where the two come in contact; by its not blending so closely with the pelvic wall; by its presenting to the examining finger a portion of the rounded outline of the tube or ovary; and by absence of the cartilaginous hardness often seen in chronic parametrial masses.

Persistence of Virulence.—The virulence of the streptococcus persists indefinitely. Miller reports one case in which the bacteria persisted for six years and another in which they persisted for twelve years. Martin states that streptococci have been found fully virulent in a pelvic inflammatory mass after nineteen years. In one instance (case 19) streptococci apparently disappeared in six months, but the pus also disappeared. The case was one of severe sepsis following labor. On the eighth day vaginal incision into a pelvic abscess evacuated pus containing streptococci. Six months later, a mass persisting, a vaginal incision was made into the cul-de-sac and the mass. No pus was found, but there was serous fluid showing staphylococci alone.

Automatic sterilization of a streptococcus abscess is perhaps–possible, but it is so rare that it is not to be counted on. A streptococcal mass in the pelvis is always dangerous, and abdominal section for that cause at any time is likely to be followed by a fatal peritonitis. The cases tabulated give striking proof of the seriousness of intraperitoneal operation in these cases.

5. What is the **preferable time** for abdominal operation for a chronic inflammatory mass in the pelvis? This varies in different cases, as follows:

a. In a case that is *clearly gonococcic* (agreement on the two points—the apparent cause of the trouble and the location of the lesion) abdominal operation may be considered safe after *three or four months* from the onset of the

trouble. If after this time the mass is a source of serious irritation in spite of palliative treatment, it should as a rule be removed. On the other hand, if there is marked improvement, it is better to wait, as there may be a spontaneous cure.

b. In a case that is *clearly streptococcic* (agreement on the two points) abdominal section is *never safe*. Even where the temperature and pulse are normal and everything quiescent, intraperitoneal operation for the mass may cause the patient's death from streptococcal peritonitis.

c. In a case that is doubtful (disagreement on the two points) a most careful study should be made of all the features of the case and every helpful diagnostic method should be brought into use to aid in reaching a definite conclusion. No intraperitoneal operation should be undertaken until the streptococcus is excluded with reasonable certainty. In a doubtful case in which the abdomen is opened on the supposition that the mass is tubo-ovarian and it is found before adhesions are much disturbed that the mass is principally in the connective tissue (parametritic), the route of attack should be changed to extraperitoneal (per vaginam or above Poupart's ligament) and the abdominal wound closed. Such a lesion probably contains streptococci and the adhesions of omentum and bowel, which cause the deceptive mass high in the tubal region, constitute the protective barrier between the virulent bacteria and the peritoneal cavity. When this barrier is broken down, the way is opened for a fatal peritonitis.

6. Other treatment measures. In the treatment of old inflammatory infiltration in the connective tissue of the pelvis, the various conservative measures may be tried, selecting those which seem best adapted to the particular conditions present in the case. Deep heat, with diathermy or the Elliott apparatus, may give sufficient relief. If there is evidence of pus in the induration, vaginal drainage is indicated. Any active inflammation may call for the internal administration of some one of the sulfonamides.

Complicating conditions are to be searched for and relieved. An associated chronic cervicitis should be eliminated, as bacteria from it may be keeping up the parametritis. Also, the excision of an enlarged cervix may aid in relieving dyspareunia if present. If the trouble is persistent and disabling in spite of other measures operation on the mass must be considered. The safest way to operate for streptococcal pus collections is by the extraperitoneal method. If possible, the pus collection should be reached and evacuated per vaginam. If this cannot be accomplished, it may be practicable to drain the abscess by extraperitoneal operation above Poupart's ligament, as was done in some of the cases reported. Intraperitoneal operation in these cases should be undertaken only when the patient's life is threatened by the severity of the inflammation and it is impossible to reach the mass in a less dangerous way.

OTHER DISEASES

of Fallopian Tubes, Pelvic Peritoneum and Pelvic Connective Tissue

The following conditions will be considered in the order given: Extrauterine pregnancy, other pelvic hemorrhages (from graafian follicle or tumor), tubal tuberculosis, tumors of fallopian tubes, torsion of adnexa, varicose veins of broad ligaments, and miscellaneous rare conditions.

EXTRAUTERINE PREGNANCY

Extrauterine pregnancy is pregnancy outside the uterine cavity. With few exceptions the developing embryo is, in the beginning, located in the fallopian tube (Figs. 909, 910), consequently the term "tubal pregnancy" is applicable in most cases. The lodgment and development may occur at any part of the tube, as indicated in Fig. 911. A pregnant tube may rupture and discharge the embryo and blood mass into the peritoneal cavity, in which case there may be complete severance of the vascular connection or the cord may remain attached in the tube wall and continue to nourish the embryo, or the embryo may remain within the tube and grow there. Occasionally the fertilized ovum lodges and develops in the ovary (ruptured follicle or other crevice) or in some other part of the peritoneal cavity.

The condition is designated also "ectopic gestation" and "abdominal pregnancy." Certain forms are given special names, for example, "ampullar" pregnancy (in outer dilated part of tube), "isthmial" pregnancy (in narrow part of tube near uterus), and "interstitial" pregnancy (in interstitial part of tube, which is in the uterine wall). This last type of "extrauterine" pregnancy is within the uterine wall, but not in the cavity, unless it breaks in during development.

Extrauterine pregnancy occurs on the average about once in every two hundred cases of pregnancy, and in about 2 per cent of gynecologic cases. Though furnishing some of the most striking and severe and easily recognized cases of internal hemorrhage, the majority of cases present at first simply recurring mild attacks of pelvic disturbance. Consequently, the condition is often mistaken for threatened miscarriage or pelvic inflammation, until a severe attack shows some additional factor and starts investigation which leads to the diagnosis of tubal pregnancy.

Etiology

The cause of extrauterine pregnancy is some interference with the downward progress of the fertilized ovum. The ovum and spermatozoa meet normally in the tube, and after fertilization the ovum passes along the remainder of the tube and into the uterus, where, having reached the trophoblast stage,

Fig. 909.

Fig. 910.

Fig. 909.—Specimen of Tubal Pregnancy, showing the small embryo in its sac and old blood clots in the tubal lumen and hemorrhagic areas in the tubal wall.

Fig. 910.—The other side of the specimen, showing the rupture in the tubal wall, through which blood clots may be seen. Gyn. Lab.

it becomes attached and develops, constituting a normal pregnancy. Now, if the progress of the fertilized ovum is interfered with so that it remains in the tube and develops up to its trophoblast stage there, extrauterine pregnancy is the result. The tubal obstruction must, of course, not be so marked as to prevent the upward progress of the spermatozoa; consequently extrauterine pregnancy is impossible when both tubes are completely occluded by inflammation or other process.

The conditions which interfere more or less with the downward progress of the ovum are as follows:

1. Mild salpingitis. Slight inflammation may lead to destruction of the cilia. The action of the cilia is supposed to be necessary to the normal progress of the ovum from the abdominal to the uterine end of the tube, the peristaltic action of the tube being of secondary importance and not sufficient in itself to carry the ovum along.

Again, such inflammation leads to swelling of the tubal mucosa and mechanical obstruction in the various portions of the tube. This obstruction, while not marked enough to prevent the upward progress of the active spermatozoa, may prevent the downward progress of the passive ovum.
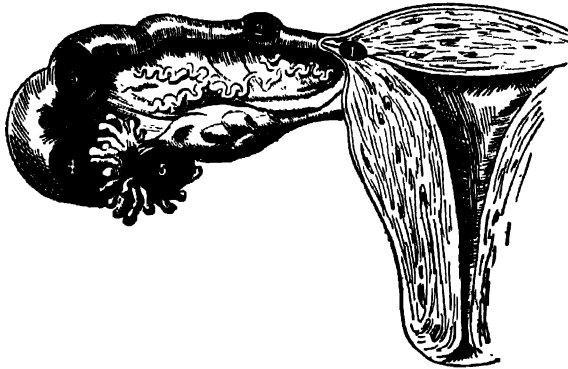
Fig. 911.—Diagram representing the sites for the various forms of tubal pregnancy. *1*, Interstitial pregnancy. *2*, Isthmial pregnancy. *3*, Ampullar pregnancy. *4*, Infundibular pregnancy. *5*, Tuboovarian pregnancy. (Gilliam—*Practical Gynecology*, F. A. Davis Company.)

2. Adhesions, from inflammation originating in the tube or elsewhere, may so distort the tube by bending or pressure as partially to obstruct its lumen.

3. Tumors within the tube wall or arising from other structures may by pressure narrow the lumen of the tube.

4. Malformations. Abel agrees with Freund that some of the spiral twists which are normally present in the tube in the embryo may persist to adult life and cause sufficient obstruction to lead to extrauterine pregnancy. Diverticula may lead off from the lumen of the fallopian tube. If a fertilized ovum lodges in one of these blind canals, tubal pregnancy will result. There may be also accessory tubes.

A rudimentary tube which is not open all the way to the uterus may be entered by an ovum which has been fertilized by a spermatozoon passed through the normal tube of the opposite side. The large fertilized ovum is stopped at the impervious portion of the deformed tube, and a tubal pregnancy is the result. Kelly illustrates an interesting case in which this same series of events occurred in a rudimentary uterine horn, the horn being so separated from the remainder of the uterus that it resembled part of the tube (Fig. 1059).

Pathology

When the ovum becomes attached to the tube wall, certain changes begin. First, there is marked hyperemia, which leads to some swelling of the structures

and to increased growth of all the tissue elements of the tube wall. In the mucosa in tubal pregnancy the stroma cells enlarge and become decidua cells, though they do not become so large or so closely packed together as in the uterine mucosa. There is some hypertrophy of the muscular tissue near the attachment of the ovum. Very soon there appear certain interesting changes

A.   *II.*
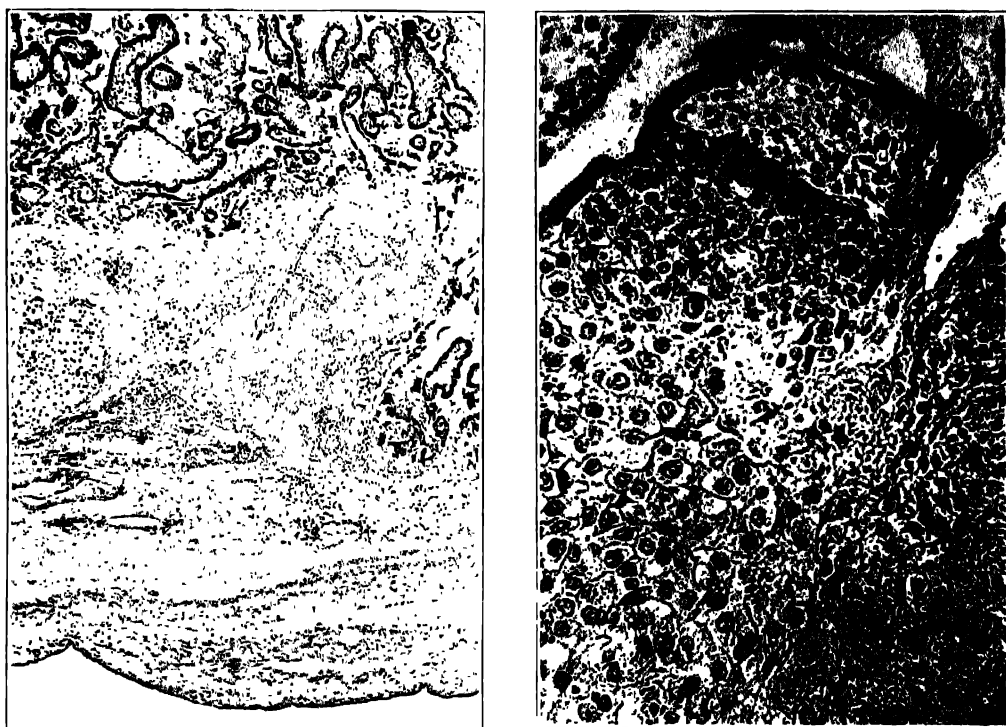
Fig. 912.—Tubal pregnancy. *A,* Section of wall and chorionic area, low power. Notice at the right how the tube wall is being penetrated. *B,* High power of *A,* showing decidua cells and the attachment of chorionic villi. Gyn. Lab.

Fig. 913.—Bilateral tubal pregnancy. Drawing showing the conditions found at operation. Pregnancy near the middle of one tube and at the outer end of other, both ruptured. Tubal abortion on left side. (Findley—*Surg., Gyneo. and Obst.*)

that have a bearing on the early rupture of the pregnant tube. As the fetal elements reach into the tubal tissues, seeking nourishment, the wall of the tube becomes penetrated by cells of the trophoblast layer, and the resulting blood vessel disturbance causes hemorrhage into the wall tissues and into the lumen of the tube, as shown in Fig. 909. The trophoblast cells work into the muscular layer and weaken it, and gradually penetrate all the way through

the wall, causing an early small rupture. Later, the weakened area is extended and the opening in the tube wall becomes larger, as shown in Fig. 910.

On opening the tube, the amniotic sac and frequently the ovum may be seen and there is usually a partially organized blood clot filling the rest of the lumen, as in Fig. 909. But in some cases the blood clot is all that is seen.

Fig. 914.—Early tubal pregnancy with twin embryos. (Jewett—*Am. J. Obst. & Gynec.*)

Fig. 915.

Fig. 916.

Fig. 915.—Advanced tubal pregnancy mass, the contents of which are shown in Fig. 916.
Fig. 916.—Twin fetuses from a tubal pregnancy which had advanced to term. (Ferguson and Otis—*Am. J. Obst. & Gynec.*)

Microscopically, trophoblast cells and decidual cells are seen, much as they are in a uterine implantation. Fig. 912 shows the characteristic changes in the tube wall. A hemorrhagic mass in the tube at operation does not necessarily mean tubal pregnancy, for hemorrhage in the tube may be due to some other cause.

If the blood supply is shut off from the growing ovum, it dies and becomes absorbed or calcified. If sufficient circulation is maintained to support life, the ovum continues to grow. A number of cases of full-term extrauterine pregnancy have been reported.

Accompanying the tubal pregnancy there is a decidual reaction in the uterus and this decidua is frequently passed as a cast of the uterine canal. When this does occur it aids in diagnosis. Not infrequently there is an accompanying decidual reaction in the peritoneum and in the ovary.

Several cases of bilateral tubal pregnancy (Fig. 913) have been reported, so it is well at operation to examine the other tube carefully also. Occasionally the tubal pregnancy is a twin pregnancy, as shown in Figs. 914 to 916.

Types of Cases

Clinically, the cases may be divided into the following classes:

1. **Before Rupture.**—The developing embryo with its membranes is still completely surrounded by the unbroken tube.

Fig. 917.   Fig. 918.

Fig. 917.—Tubal pregnancy, with abortion through the abdominal end of the tube into the peritoneal cavity. The end of the tube is dilated, but the structures have not yet been extruded. (Kelly—*Operative Gynecology*.)

Fig. 918.—The clots, membranes, and embryo extruded into the peritoneal cavity. (Kelly—*Operative Gynecology*.)

2. **Tubal Abortion.**—If the place of lodgment of the fertilized ovum happens to be near the outer end of the tube, the enlargement of the lumen by the developing embryo opens the end of the tube, and the embryo and its membranes may be extruded through this opening into the peritoneal cavity, as shown in Figs. 917 and 918. This is called "tubal abortion." Tubal abortion is accompanied with more or less intraperitoneal bleeding.

The blood gravitates into the cul-de-sac of Douglas. Adhesions bind together the structures above, thus forming a roof which shuts off the blood-filled cul-de-sac from the remaining part of the peritoneal cavity as indicated in Fig. 919. This condition is known as "pelvic hematocele." The blood may be gradually absorbed without further disturbance or the hematocele may require drainage, as described under Treatment. The very early embryo with mem-

branes, having been completely cast off from its point of nourishment, perishes, and is usually absorbed without causing further trouble.

3. **Intraperitoneal Rupture With Single Moderate Hemorrhage.**—The process is practically the same as described for tubal abortion, except that the small embryo and membranes and blood clot are extruded through a rent in the tube wall instead of through the dilated fimbriated end. The symptoms are usually somewhat more severe.

4. **Intraperitoneal Rupture With Repeated Moderate Hemorrhage.**—The membranes usually remain partially attached within the broken tube, and hence the extruded embryo continues to grow, causing trouble later. The first hemorrhage leads to peritoneal exudate, with resulting adhesions, which bind together adjacent structures. Thus the blood mass and broken tube and
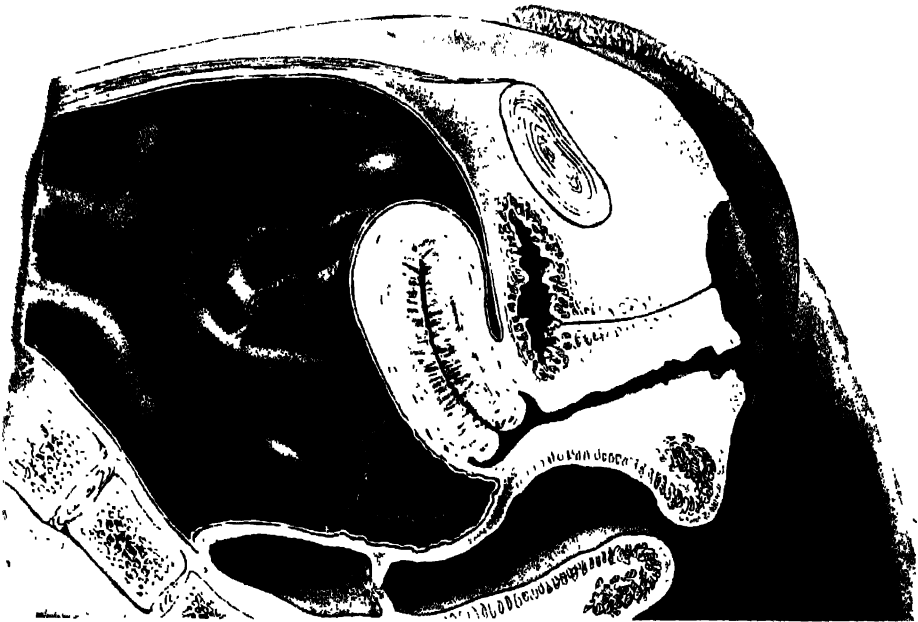
Fig. 919.—Pelvic hematocele. Indicating the condition where there has been a tubal abortion and the blood from it has gravitated to the cul-de-sac and become surrounded by exudate.

growing embryo are surrounded by a wall of exudate and adherent intestine. This wall lessens the danger temporarily. But after a few days or a few weeks the continued growth causes further rupture of the tube or of the other limiting tissues, with accompanying fresh intraperitoneal hemorrhage of small or large amount. More exudate is then thrown out about the new blood mass, lessening the danger for a time. This process may be repeated many times within the course of a few months, provided the patient does not in the meantime succumb to hemorrhage or peritonitis. Thus there is found in this class of cases (Figs. 920 and 921), a gradually increasing mass, accompanied by frequent attacks of pelvic pain and marked soreness. This class includes the majority of cases of extrauterine pregnancy that come to operation. Whether or not the patient's color and pulse are much affected depends upon the

severity of the hemorrhages. In many cases the recurring pain and soreness are the most evident features, and at the bedside such cases are often mistaken for ordinary pelvic inflammation.

5. **Intraperitoneal Rupture With Profuse Hemorrhage.**—There is a free rupture of the tube, and blood pours out into the peritoneal cavity rapidly and

Fig. 920.—Tubal pregnancy, with rupture into the peritoneal cavity. (Gilliam—*Practical Gyne-cology.*)
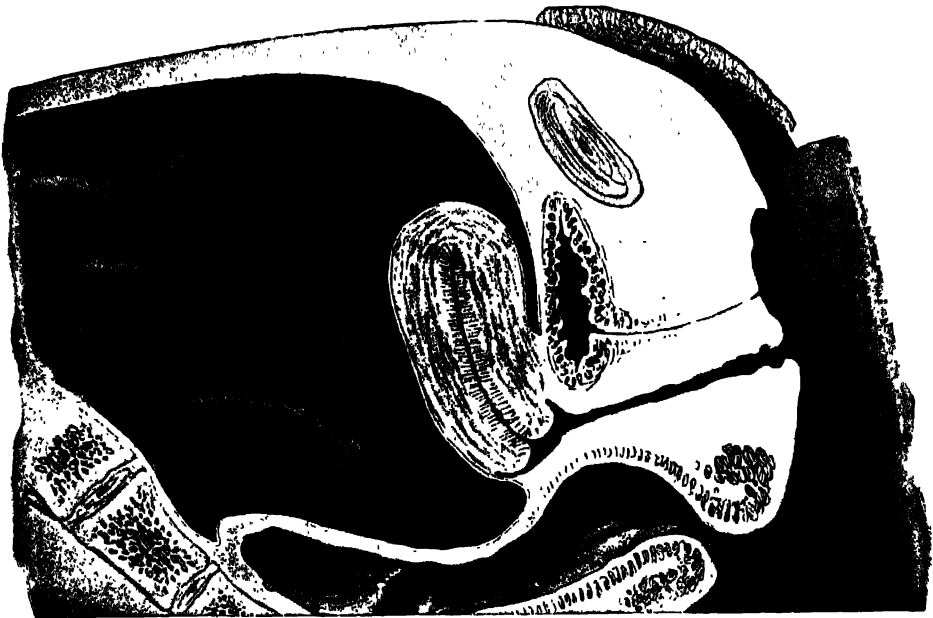
Fig. 921.—Blood mass about tube. Indicating the condition where there has been rupture of the tube, with repeated slight hemorrhages, resulting in a large mass of blood and exudate, which surrounds the tube.

in great quantity. It extends among the intestines and in some cases practically fills the abdominal cavity, as indicated in Fig. 922. The patient at once passes into a condition of severe shock. She is blanched, almost pulseless and, with the air-hunger and extreme pain, presents a most distressing picture. The cases of this class have been fittingly designated as the "tragic" cases. This severe and persistent hemorrhage is most likely to occur when the develop-

ing ovum is situated near the uterus, in that portion of the tube known as the "isthmus," as in Fig. 923. In the vast majority of cases the bleeding ceases when the patient passes into complete shock, which is nature's provision for checking the hemorrhage. In exceptional cases, however, the patient does actually bleed to death, either from the first free flow or from a renewal of the bleeding due to vomiting, bowel movement, sitting up, or other disturbance of the newly formed clot.
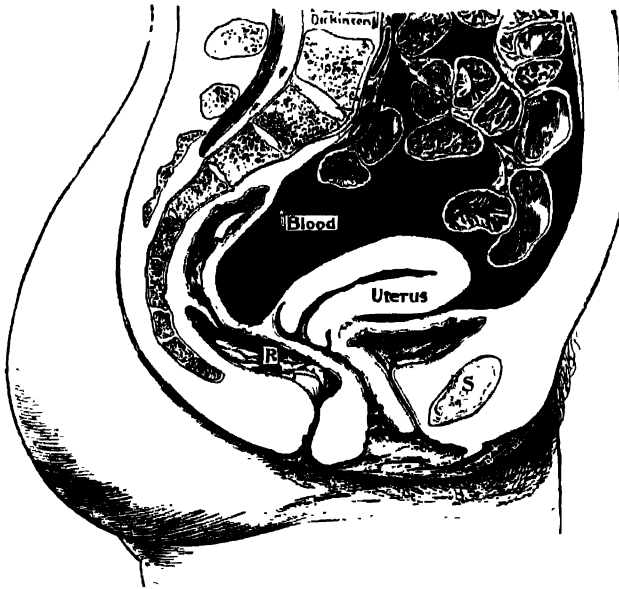
Fig. 922.—Tubal pregnancy with free intraperitoneal hemorrhage, showing a large amount of blood in the peritoneal cavity among the intestinal coils. This constitutes the "tragic" type, in which there is a sudden large hemorrhage and the patient goes into collapse. (Dickinson—*American Textbook of Obstetrics*.)

Fig. 923.—Tubal pregnancy in the narrow portion of the tube (isthmus) close to the uterus. This is the type in which the primary hemorrhage is likely to be very severe. Gyn. Lab.

6. **Rupture Into Broad Ligament.**—When the break in the tube wall takes place between the layers of the broad ligament, the hemorrhage is into the connective tissues of the pelvis—forming a "hematoma," as shown in Fig. 924. The hemorrhage may be moderate, forming a hematoma in one broad ligament, or it may be severe, forming a hematoma which gradually extends until it fills most of the connective tissue space in one or both sides of the

pelvis. If the extruded embryo continues to grow in the broad ligament, then arises the condition designated as "broad ligament pregnancy."

7. **Interstitial Pregnancy.**—When the ovum lodges and develops in the interstitial portion of the tube, the resulting condition is known as "interstitial
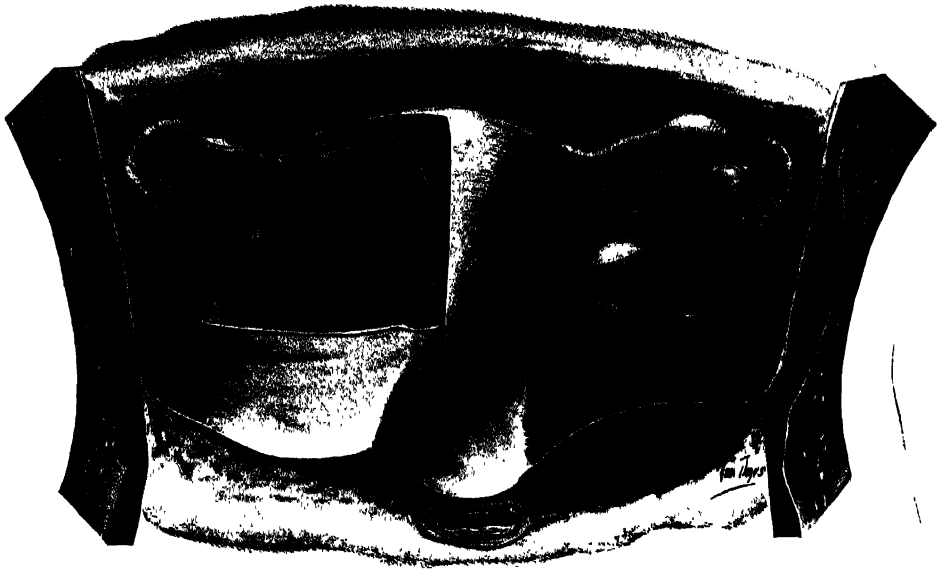
Fig. 924.—Hematoma. In the left broad ligament is indicated a small hematoma from rupture of the tube. In the right broad ligament is indicated a much larger hematoma.
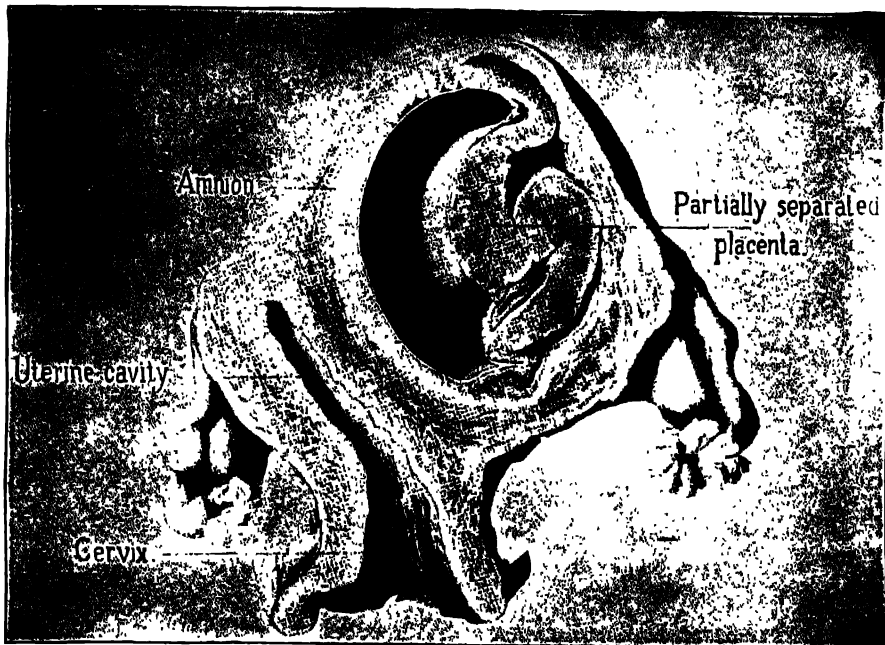
Fig. 925.—Interstitial pregnancy. (Williams, after Bumm—*Obstetrics.*)

pregnancy." This is peculiar in that the development takes place within the wall of the uterus, though outside the uterine cavity (see Fig. 925). In this form of tubal pregnancy, rupture of the gestation sac usually does not take

place until much later than with the ordinary form. Also, the rupture may in some cases be into the uterine cavity. Consequently there is a possibility of this form of tubal pregnancy terminating as a normal (intrauterine) pregnancy. Interstitial pregnancy in the early stages approaches in symptoms and signs very close to normal pregnancy, and hence presents more difficulties in diagnosis than a pregnancy farther out in the tube. It is difficult and sometimes impossible before operation to distinguish between interstitial pregnancy and pregnancy in a rudimentary horn of the uterus (cornual pregnancy). The latter is an intrauterine pregnancy in an abnormally shaped uterus and does not belong to the affection now under consideration (extrauterine pregnancy), though it may require the same operative treatment.

8. **Ovarian Pregnancy.**—If the developing ovum is found within the ovary, it constitutes "ovarian pregnancy," of which a few well-substantiated cases have been reported.

9. **Wandering Pregnancy.**—If the pregnancy is found in the peritoneal cavity without any apparent connection with the tubes, or uterus, or ovary, it is called a "wandering pregnancy," after the manner of designating fibroids which have lost their connection with the uterus. Such a pregnant mass

Fig. 926.—Bones removed from the rectum in a case of ectopic pregnancy. The ectopic pregnancy terminated by skeletinization of the fetus and extrusion into the rectum. (Gustafson --J. A. M. A.)

(fetus and surrounding membranes) may be attached to and receive blood supply from various structures. In an interesting case reported by Tuholske the placenta was attached to the liver, creating a most serious condition. "Abdominal pregnancy" is a general term which has been used to designate cases of pregnancy developing in the peritoneal cavity, with or without connection with the tube or ovary.

10. **Extrauterine Pregnancy Carried to Near Term.**—The fetus may develop to term. The embryo and membranes remain attached to the tube and derive nourishment there, and the fetus develops in the peritoneal cavity almost the same as in the uterus. In this class of cases, if the patient survives long enough and the fetus continues to grow to term, false labor pains come on and the child dies, and it then constitutes a foreign body in the abdomen. Again, the embryo and membranes may be extruded entirely from the tube and find attachment to some adjacent structure, from which nourishment is derived, or to some distant structure—for example, the liver, as in the case mentioned above. In a rare case the tube itself may gradually enlarge and accommodate the growing fetus, as in the case reported by Schumann.

Fig. 927.   Fig. 928.

Fig. 927.—Extrauterine pregnancy with lithopedion. Showing the lithopedion in situ.
Fig. 928.—Showing the lithopedion removed, and also the site of the tubal pregnancy.
(Kelly—*Operative Gynecology.*)

Fig. 929.—X-ray of a calcified tumor mass containing fetal bones. This was an eight months' extrauterine pregnancy, calcified and retained for forty years. (Titus and Eisaman—*Am. J. Obst. & Gynec.*)

In a few reported cases of extrauterine pregnancy carried to near term, the condition has been recognized in time and the child saved alive by operation.

11. **Secondary Changes.**—Suppuration may take place, and operation for the pelvic inflammatory mass reveals remnants of the tubal pregnancy. If the embryo had advanced to bone formation, the bones are found in the abscess. Occasionally such an abscess will rupture into the bladder or rectum, discharging pus and pieces of bone, to the astonishment of the attending physician. Fig. 926 shows the bones discharged from the rectum in such a case.

In other cases the tissues of the encapsulated dead fetus undergo a kind of fatty degeneration which converts them into "adipocere." Occasionally some calcification of the soft tissues of the fetus takes place, forming a "lithopedion," shown inside the abdomen in Fig. 927 and outside with attachment to tube in Fig. 928. Such calcification and fetal bones, if any, may produce some surprising items in x-ray films of the abdomen. Extrauterine pregnancy must be considered whenever bizarre shadows are incidentally encountered in abdominal films. An eight-months' extrauterine pregnancy which became calcified and was retained for forty years is shown in Fig. 929.

Symptoms and Diagnosis

This subject is of interest to everyone called to make a diagnosis in acute abdominal affections, for tubal pregnancy must be considered along with the other conditions which produce sudden abdominal pain and severe shock. There are, however, certain symptoms that usually precede the sudden internal hemorrhage and which help to differentiate tubal pregnancy from the other causes, and these differentiating items must be inquired about before making the diagnosis of ruptured tubal pregnancy. Not infrequently, in cases diagnosed and operated on as such, the operation has revealed that the trouble was not tubal pregnancy but some entirely different condition. On the other hand, many cases of tubal pregnancy with less severe symptoms are treated as pelvic inflammation or as threatened miscarriage, until the persistence of the trouble or a severe attack arouses suspicion of something more serious.

The symptoms of early tubal pregnancy are (1) a missed menstruation, (2) sudden onset of pain (with or without shock), (3) bloody vaginal discharge, (4) a tender mass beside the uterus, (5) only slight fever, (6) evidence of internal hemorrhage, (7) exacerbations of pain and enlargement of the mass without corresponding elevation of temperature, (8) symptoms of early pregnancy, (9) positive Aschheim-Zondek reaction, and (10) exclusion of intrauterine pregnancy.

Suppose that you are called to see a patient with pain in the pelvis and lower abdomen, and a tender mass beside the uterus or behind it. Is the trouble ordinary pelvic inflammation or is it tubal pregnancy? As ordinary pelvic inflammation, in the form of salpingitis, is the more common affection, it is to be assumed that the trouble is ordinary pelvic inflammation and not tubal pregnancy, unless there are special symptoms pointing to the latter.

The **special symptoms** pointing to tubal pregnancy (but not pathognomonic of it) are as follows:

1. **Missed Menstruation.**—The patient, previously regular in her menstruation, fails to menstruate at the proper time. She goes overtime a few days or a week, or several weeks.

2. Sudden Onset of Pain.—After going overtime for a few days or a few weeks, the patient is suddenly seized with pain in the pelvis, usually severe enough to confine her to bed, and in exceptional cases she is completely prostrated and in collapse.

3. Bloody Vaginal Discharge.—Usually within a few days of the onset of the pain a blood-stained vaginal discharge appears. The patient regards this as the return of the menstrual flow. But generally it is not so free as the regular menstrual flow, and does not stop in a few days as the menstrual flow should, but persists as an irregular bloody discharge for a week or two—some days present and other days absent. In some cases there are shreds of membrane and blood clots in the discharge, leading to the supposition that a miscarriage has taken place.

4. Tender Mass.—This may be well out in the adnexal area or in against the uterus laterally or posteriorly.

5. Only Slight Fever.—The temperature may go up to 102° or even higher at the onset of the trouble, but after that it usually ranges about 100° and may go to normal. The absence of marked fever is one of the strong points in distinguishing tubal pregnancy from early abortion with persistent bloody discharge and infection and salpingitis.

6. Evidence of Internal Hemorrhage will, of course, vary with the amount of blood lost internally. If the internal hemorrhage is free, the patient may be in collapse within a few minutes after the onset of the pain. In other cases the internal bleeding is so slight as to produce no effect on the patient's pulse or color—but it causes pain.

7. Exacerbations of Pain Without Apparent Cause and Without Decided Elevation of Temperature is characteristic of those cases of tubal pregnancy in which there are repeated slight internal hemorrhages.

In salpingitis, with the patient quiet in bed, such exacerbations of pain could be caused only by an increase in the inflammatory process, and this would be accompanied by a decided rise in temperature.

8. Signs of Pregnancy.—Some of the early signs of pregnancy may be present—for example, stomach disturbance, or pain in the breasts, or softening of the cervix uteri.

9. Positive Aschheim-Zondek Pregnancy Test.—This is decisive in differential diagnosis between tubal pregnancy and other extrauterine masses in cases in which intrauterine pregnancy can be positively eliminated. There are, however, certain complications or sequelae of intrauterine pregnancy which may continue the positive Aschheim-Zondek long after the termination of the pregnancy, as in remnants of hydatidiform mole or in chorio epithelioma.

10. Absence of Intrauterine Pregnancy.—It may be very difficult to determine, in a given case, whether the trouble is tubal pregnancy with slight hemorrhage, or an incomplete abortion with persistent bleeding and mild sepsis and salpingitis. In such a doubtful case the uterus may be cleared out with the curette and the scrapings examined. If there has been recent pregnancy within the uterus, the microscopic examination of the tissues removed will show chorionic villi. If the trouble is tubal pregnancy, there will be no fetal structures in the scrapings.

This procedure is somewhat dangerous, for, if tubal pregnancy be present, a fresh hemorrhage and a serious one may be started by the manipulations. Consequently, curettage should be employed in these doubtful cases only when serious symptoms make a positive diagnosis necessary at once. In such a case the operator should have arrangements made so that immediate abdominal section may be carried out should threatening symptoms indicating internal hemorrhage arise during the process of curettage.

11. X-Ray Examination Findings.—X-ray examination may help materially in the differential diagnosis, by positive findings or by negative findings or by both—the significance of the findings depending on the type of tubal-pregnancy lesion under consideration and the conditions from which it must be differentiated.

Special Conditions.—There are two special conditions or stages of extra-uterine pregnancy in which the symptoms may so closely simulate normal pregnancy that the true condition is overlooked, namely, before rupture and near term.

Before Rupture.—Previous to primary rupture the symptoms are practically those of an early pregnancy. The patient goes over her menstrual time without the menstrual flow appearing. There is some nausea, usually most marked in the morning, and perhaps some tenderness of the breasts. Pain is not necessarily present. There may be some soreness in the pelvis, either general or localized to one side, but this is rarely troublesome enough to arouse suspicion of anything abnormal, for some soreness through the pelvis is very common in normal pregnancy owing to the marked congestion and the enlarging uterus and the new corpus luteum.

Pelvic examination at this stage shows some tenderness about the adnexa of one side, and perhaps a small mass, due to the enlargement in the tube. Normal ovaries, however, are usually tender in early pregnancy, and the tenderness is frequently more marked on one side. The small mass in the tubal region is really the only positive evidence of any abnormal condition within the pelvis, and as far as known this mass may have been there for a long time, due to some previous trouble. Unless a previous examination has shown the pelvis to be clear, making it certain that the little mass is of recent development, the diagnosis of tubal pregnancy is hardly justified, for there is not sufficient evidence to establish it.

A diagnosis based upon such insufficient evidence will prove erroneous in the great majority of cases, as has been amply demonstrated by the operative results from such hasty diagnoses. In exceptional cases the soreness will be so well localized to one side and so marked, particularly on exertion, and the tenderness of the little mass so very pronounced on palpation, in a patient previously perfectly well, that with a positive Aschheim-Zondek reaction a diagnosis of tubal pregnancy with operation for it before rupture may be safely made. But such cases are very rare, the conditions so closely simulating normal pregnancy that no suspicion of abnormality is aroused, or, if aroused, the differential examination signs are not positive.

It seems probable that a large proportion of the cases set forth as diagnosed and operated on "before rupture" are really not seen until after the primary rupture. There may not be much disturbance from this first rupture, only a very slight hemorrhage taking place. But this is sufficient to give the few sharp pains, and the persistent soreness, and the markedly tender mass without apparent cause—the three symptoms that occupy such an important place in the diagnosis of tubal pregnancy after rupture.

Be careful (1) to make a pelvic examination in every case of early pregnancy in which there is sufficient pain or soreness in the pelvis to arouse suspicion of some abnormality, (2) to make no positive diagnosis of tubal pregnancy unless the physical signs justify it, and (3) to pronounce no case "before rupture" which shows blood in the pelvis, or recent plastic exudate and adhesions about the tube, or damage to the peritoneal coat of the tube at the time of operation.

Near Term.—It is well to be suspicious of extrauterine pregnancy when your obstetric patient has "false pains" a great deal or fails to go into labor on time or when some of the examination-signs are not clear. One expects a history of a stormy course in an extrauterine pregnancy, but occasionally the early trouble is of short duration and after that the fetus develops with sur-

prisingly little disturbance. Also, the patient's plausible assumptions that the various abdominal discomforts were due to common ailments, may throw one off guard. In all cases it is important to determine definitely that the fetus is really in the uterus.

In the case of a large mass in which the diagnosis lies between extrauterine pregnancy near term and a large tumor or intrauterine pregnancy or a combination of tumor and pregnancy, x-ray examination may aid by showing fetal bones within the uterus or outside it or possibly by showing mass outlines which aid interpretation.

Even with x-ray examination, however, the diagnosis may be difficult. Aschman and Helwig report an instructive case in which examination findings, including a check-up x-ray film, so closely simulated those of intrauterine pregnancy that that diagnosis was made. Six months later, the patient returned with the mass no larger and with evidences of extrauterine pregnancy, which diagnosis was confirmed by operation.

Another instructive case is that reported by Friedman. This patient came to the prenatal clinic in March, and examination revealed a pregnancy in the fourth month. After that she was examined regularly in the clinic until August, when they became suspicious of extrauterine pregnancy. An x-ray film was made. This and the physical signs indicated that the fetus was outside the uterus, and an opaque injection into the uterus confirmed that diagnosis. Incidentally, this patient had had a tubal gestation six years before, for which she had operation with right salpingo-oophorectomy. In another reported case the patient had a combination of lithopedion in one side of the abdomen and a living fetus in the other side.

Treatment

In pointing out the treatment for extrauterine pregnancy, several clinical classes must be considered—namely (1) before rupture, (2) hematocele, (3) repeated moderate intraperitoneal hemorrhage, (4) profuse intraperitoneal hemorrhage, (5) hematoma, and (6) advanced cases.

1. **Before Rupture.**—The only safe line of treatment in this stage is abdominal section and removal of the pregnant tube as soon as the diagnosis is fairly certain. The patient is in constant danger of a sudden serious hemorrhage, hence the sooner she is operated on the better.

2. **Pelvic Hematocele** (Fig. 919).—In these cases the hemorrhage has long sinced ceased and the collection of blood in the pelvic cavity is well shut off from the general peritoneal cavity by plastic exudate and adhesions. The embryo and membranes have probably escaped from the tube, either through a rupture in the wall or more frequently through the end of the tube by "tubal abortion," and perhaps have been largely absorbed.

Practically all that remains is the blood in the pelvis, with the exudate and adhesions around it. This forms a tender mass low in the cul-de-sac back of the uterus, without much disturbance higher.

In such a case it is well to watch the patient for a while, in the meantime keeping her quiet in bed. In the course of a week or ten days there will probably be decided improvement, showing that nature is taking care of the blood

and exudate, and that the patient will probably recover without operation, or renewed evidences of irritation will appear, showing that embryo and chorion are still growing or that the blood and exudate are acting as a persistent source of irritation. When there is persistent irritation after this period of rest, operation is indicated.

The choice of operation depends on the circumstances of the case. If the evidences of irritation (pain and tenderness) are all low in the cul-de-sac, the probability is that evacuation of the blood from the cul-de-sac by vaginal section will be all that is necessary. If the pain and tenderness extend into the upper part of the pelvis, abdominal section is the safer operation. When the conditions are doubtful, the abdominal route should be chosen.

In a case in which a hematocele is to be evacuated by vaginal section, the patient should be prepared for an abdominal section also, for there is a possibility of the vaginal manipulations starting an internal hemorrhage which could not be satisfactorily controlled from below.

3. **Repeated Moderate Intraperitoneal Hemorrhage** (Fig. 921).—This class comprises the majority of the cases of tubal pregnancy. The treatment is abdominal section as soon as the diagnosis is positive and the patient can be placed in a hospital and given the regular careful preparation for that operation.

4. **Profuse Intraperitoneal Hemorrhage** (Fig. 922).—In these cases immediate abdominal section is advisable as a rule if the patient is within reach of an experienced abdominal surgeon and can be placed in suitable surroundings. In the absence of an experienced operator and suitable facilities, operation had best be deferred.

In operations for the various classes of cases of extrauterine pregnancy, as well as other conditions in which abdominal section is required, the patient's chance of recovery is greater if the operation can be conducted in a well-ordered hospital. Consequently, the patient should be taken to a hospital if possible. Even a trip on the train, with the patient on a stretcher and in a strictly recumbent posture all the time, is less hazardous than operation in poor surroundings. The marked emphasis which teachers and writers generally have placed upon promptness of operation in extrauterine pregnancy has unfortunately led to considerable indiscriminate operating in these cases—operations on patients in which it would have been safer to wait a while, operations without adequate aseptic preparation, operations by persons without sufficient surgical experience to handle the serious intra-abdominal conditions in a safe and effective way.

Even in the restricted class of cases in which there is free intraperitoneal hemorrhage, the so-called "tragic" cases, it is probable that not many patients really die at once from the loss of blood. There are some that do, but they are comparatively few, as indicated by mortality records and by the number of patients that come to operation later with a history of having passed through a severe attack. It is the repeated hemorrhages, with the resulting peritoneal irritation and inflammation, coming on within a few days or a few weeks, that constitute the greatest menace and that cause the death, rather than the mere withdrawal of a certain amount of blood from the circulation at the primary rupture. This being the case, the patient has a better chance of surviving the

primary loss of blood if simply kept quiet without operation, than if operated on at an inopportune time or without reliable aseptic preparation or by a person without adequate experience in abdominal surgery.

In most of these cases, the hemorrhage has ceased by the time the physician reaches the patient. Whether this is the case can be determined with a fair degree of certainty, as a rule, by watching the patient for a short time. If the hemorrhage has ceased, it will be seen that the pain is diminishing and the pulse, though weak, remains about the same in rate and volume. The immediate requirements are (a) to make hospital arrangement and summon an ambulance to take the patient there, (b) to relieve pain and quiet the patient, and (c) to lessen the severe thirst caused by the blood loss and at the same time begin the gradual restoration of body fluids.

If there is much pain or restlessness, a hypodermic of ½ gr. codeine will help, and is less likely to cause vomiting than morphine. This moderate dose, which may be repeated later as needed, is preferable to a large dose. These patients on the borderline between life and death sometimes react unduly to the larger drug-dosages which are ordinarily perfectly safe. If the patient complains of thirst, it may be lessened by giving water by mouth, in small quantities to avoid vomiting, repeated frequently as desired, so that there is a continuous supply of fluid being absorbed from the stomach.

While waiting for the ambulance, the family is instructed as to the danger of renewed internal hemorrhage if the patient is allowed to sit up or is propped up for any reason or any attempt is made to change clothing. She must be kept horizontal with head level—even a pillow may increase cerebral anemia and start vomiting, the straining of which may cause renewed bleeding. This same precautionary information is given to the ambulance attendants, who must slide the patient from bed to stretcher in a strictly horizontal position, and must exercise the same care at the hospital end of the trip.

If the patient is in some locality where ambulance and hospital services are not available, arrangements are made at home to supply the necessary fluid and nourishment during the critical period of the next few days. Fluid may be supplied by normal saline solution subcutaneously and nourishment by 5 per cent glucose solution subcutaneously, avoiding intravenous administration of fluid in quantity because of the danger of renewed hemorrhage from raised intravascular pressure. Fortunately, materials for saline solution and for glucose solution may be purchased in convenient packages ready sterilized for use, and these, with suitable apparatus for administration, will of course be kept on hand by the physician practicing in a locality where these hospital facilities must be supplied in the home.

Glucose solution for subcutaneous use must be weak (5 per cent) and, like subcutaneous saline, is to be given slowly to permit distribution without undue local tension. As to the fluid requirements of the patient, 2,000 c.c. daily, given in two subcutaneous injections, should tide the vital forces over the acute period of three or four days. A portion of this (third to half) may be of the 5 per cent glucose, to supply nourishment. This may be given along with the saline (thus further diluting the glucose) or separately at another site. Also, the administration of amino acids is to be considered in connection with meeting the nutritional and vitamin requirements. The role of the amino acids is considered in detail in Chapter III under Plasma Balance. In addition to supplying fluid and nourishment, it is important to avoid vomiting, purgatives, enemas and pelvic examination, any one of which may disturb the pelvic structures enough to start more bleeding. _As the patient will be taking no solid food, no bowel movement is necessary in the next few days or if necessary it will come spontaneously. Straining is to be avoided, and of course a bedpan is to be at hand for urination and any bowel movement.

As the patient becomes able to take more water by mouth and, later, nourishment, the subcutaneous administration may be diminished. Iron and associated tonics, for restoration of blood cells and hemoglobin, are to be started early, perhaps by hypodermic administration and continued later by mouth. When the patient has recovered sufficiently to travel safely, she should be taken to a hospital for the deferred operation. This should not be postponed till there is additional growth of the embryo and membranes and another severe hemorrhage.

Ordinarily, we rely so much on blood transfusions and intravenous solutions in combating shock in emergencies, that they come at once to mind when confronted with this emergency. But with a serious internal hemorrhage just checked by a fresh blood clot, rendered possible by the low blood pressure of shock, which is nature's protective measure, it can be readily appreciated that safety lies in continuing the low intravascular pressure until the clot is firmly organized or until the abdomen is opened and the bleeding area under control. This applies to blood transfusion the same as to the intravenous administration of any other fluid in quantity. Hence the importance of omitting blood transfusion and intravenous glucose, until the patient is in the hospital where operation can be carried out immediately should there be evidence of renewed bleeding. When the patient is in such desperate condition from exsanguination that it is thought necessary to put some blood in the vessels, the fractional method may be employed—that is, a small quantity is given slowly with careful watching as to blood pressure, and repeated according to indications. Of course, if the patient is on the operating table, a regular transfusion may be started slowly as the operative field is being prepared, the flow to be increased as soon as the vessels are clamped. In some cases sufficient fluid blood is found in the peritoneal cavity for some to be citrated and used for transfusion, if other blood is not at hand. It is preferable, however, to use other blood for the transfusion, and leave the fluid peritoneal blood to be absorbed from there.

As to operation, the desperate cases where the vital forces are at a low ebb, require much judgment and discrimination as to when to operate in a particular case and as to just what to do at the operation—on the one hand, to stop the bleeding and thus prevent the patient from passing into an absolutely hopeless condition, and, on the other hand, to avoid snuffing out the little spark of life remaining by the added strain of intraperitoneal manipulations and anesthesia. The anesthesia and operative work must be reduced to a minimum, both in duration and in extent. Some cases can be satisfactorily operated on under local anesthesia, and occasionally there is a case in which the patient's sensibilities are so obtunded that practically no anesthesia is necessary for the work required.

5. **Pelvic Hematoma** (Fig. 924).—If there are any evidences of active or recurring hemorrhage, the preferable treatment is abdominal section with removal of the damaged tube and the blood mass. If there is simply a quiescent blood collection in the connective tissue, keep the patient quiet and watch. If the blood mass is gradually absorbed, keep the patient quiet until the mass has largely disappeared, and then she may be allowed up and be counted practically well. If the mass remains stationary and symptoms of pronounced irritation persist or arise later, the patient should be subjected to operation—abdominal or vaginal, as indicated by the location of the mass and the accompanying symptoms.

6. **Advanced Cases.**—These cases vary so much that it is impossible to give any general rule of handling. In some of them immediate operation is indicated, while in others it is advisable to wait for a time, either because the child has only recently died and the placenta and adhesions are still dangerously vascular, or, in rare cases, because there is good reason to hope for saving the child without unjustifiable risk to the mother. The problem of bleeding control at operation, whether to remove the placenta immediately or leave it in situ for a while, and various other important surgical items are discussed in *Operative Gynecology.*

OTHER HEMORRHAGES

When there is hemorrhage into the pelvis from any cause, if the blood passes into the peritoneal cavity, it is known as "intraperitoneal hemorrhage." If the amount of blood is small and becomes shut in the pelvic cul-de-sac by a roof of exudate and adhesions above, it is referred to as a "pelvic hematocele." If the blood, instead of passing into the peritoneal cavity, passes into the connective tissue, the resulting condition is called "pelvic hematoma."

The usual cause of blood in the pelvis is extrauterine pregnancy, the characteristics of which have just been presented. However, hemorrhage into the pelvis occurs occasionally from other causes. A collection of blood in the pelvis may be caused by any one of the following conditions:

1. Hemorrhage from a corpus luteum or from a follicle at time of ovulation.
2. Hemorrhage from a papillary tumor of the fallopian tube.
3. Rupture of vessel of any tumor or of a varicose vein of broad ligament.
4. Leakage from an endometrial ovarian cyst.
5. Tissue traumatism in examination, such as rupture of a thin-walled cyst or when determining a deep attachment under anesthesia or attempting reposition of a fixed uterus.
6. Traumatism in crushing accidents or falls.

The **diagnosis** is made by the same symptoms that indicate hemorrhage in extrauterine pregnancy, but without the evidences of pregnancy.

As in the vast majority of cases of spontaneous pelvic hemorrhage the cause is extrauterine pregnancy, this affection must be excluded in any particular case before any other diagnosis is permissible. Sometimes this may be excluded by the circumstances of the case—for example, the patient may be a virgin, or may be past the menopause, or may have had no recent opportunity of becoming pregnant. In some cases the differential diagnosis cannot be made until the operation, when one of the causes above mentioned may be apparent, with absence of indications of tubal pregnancy. In a doubtful case the diagnosis should be reserved until the suspicious mass, removed at operation, has been submitted to microscopic examination. In a tubal pregnancy, ruptured early and not operated on for several weeks, all naked-eye evidence of the pregnancy may disappear. But by microscopic examination of the affected tube, evidence of the pregnancy may be found.

Meigs and Hoyt reported from the Massachusetts General Hospital a series of 22 patients in whom it was found that the pelvic hemorrhage occasioning operation came from a recently ruptured follicle or a fresh corpus luteum or the edge of a ruptured cyst. Harris and Groper reported a series of 45 cases of ruptured ovarian retention cyst and collected 367 cases from the literature. From their study they reached the following conclusions:

1. For clinical purposes the term, ovarian retention cyst, is advocated in the discussions of rupture of graafian follicle and corpus luteum cysts.

2. Intraperitoneal hemorrhage from rupture of an ovarian retention cyst has not received sufficient recognition in the differential diagnosis of acute surgical abdominal conditions.

3. A classification into 3 groups of *mild, moderate,* and *massive* hemorrhage resulting from rupture of ovarian retention cyst is described. The clinical aspects of this entity are determined by the amount of intraperitoneal bleeding.

4. The mechanism of rupture may be due to increased intracystic pressure from spontaneous bleeding into the cyst, or increased extracystic pressure from trauma of various types.

5. The diagnosis of the condition is dependent upon time relation to the previous menstruation, characteristic variation in abdominal pain and tenderness, the presence of active peristalsis, and frequently positive pelvic findings. A ''high index of suspicion'' aids materially in the diagnosis.

6. Rupture of an ovarian retention cyst must be differentiated from: (1) acute appendicitis; (2) ectopic pregnancy; (3) pelvic inflammatory disease; and (4) torsion of an ovarian cyst.

7. The majority of these cases can be treated by conservative observation after the proper diagnosis is made. The tendency to recurrent attacks is rare but does occur, and the possibility of treatment by endocrine therapy is suggested in such cases.

8. Rupture of ovarian retention cysts seems to have a high incidence among nurses.

9. When surgical intervention is necessary, the entire ovary should not be sacrificed. Plastic resection of the cyst and preservation of normal ovarian tissue is advocated.

The **treatment** of pelvic hemorrhage not due to tubal pregnancy depends on the circumstances of the case. If the hemorrhage is into the connective tissue (hematoma) and well circumscribed, palliative treatment only is indicated. This consists of perfect quiet in the recumbent position, elevation of the foot of the bed and an ice bag over the abdomen, and sedatives sufficient to give rest. In intraperitoneal hemorrhage of slight extent, where tubal pregnancy can be excluded, the same treatment is indicated. In either case the effused blood may be largely absorbed. If after a time it still remains and gives trouble or suppurates, the hematoma or hematocele, as the case may be, has to be opened from the vagina, the same as a pelvic abscess.

If there is serious intraperitoneal hemorrhage, it requires abdominal section if the patient is in fit condition, the additional steps in the intra-abdominal treatment depending upon the conditions found within the abdomen.

TUBAL TUBERCULOSIS

Tuberculosis of the interior of the fallopian tubes is the characteristic pelvic type of tuberculosis. There may be secondary involvement of the tubal peritoneum and adjacent structures. It is usually bilateral. Occasionally the ovaries are involved primarily, but usually by extension from the tubes. Associated uterine tuberculosis was found in about fifty per cent of investigated cases, but there is a difference of opinion as to whether this means extension down from tubes to uterus or vice versa or by the blood stream to both. Uterine tuberculosis is considered under uterine diseases.

Extension of general peritoneal tuberculosis to the pelvic peritoneum constitutes simply a part of general abdominal tuberculosis or tuberculous peritonitis. There is involvement of the peritoneum over the tubes (Fig. 930) as well as elsewhere, but it would be misleading to include this condition in the distinctive term tubal tuberculosis or tuberculous salpingitis. This distinction is important from the treatment standpoint also, for there is ordinarily no occasion for pelvic organ removal in operations for this condition.

Etiology

The same factors are operative here as in tuberculous lesions elsewhere, namely, tubercle bacilli and lowered tissue resistance. As to how the tubercle bacilli reach these deep-seated structures, and why they locate here, is an interesting story and one not yet completed.

The following factors have a bearing on the etiology of the affection:

1. Tuberculous lesions in distant organs—for instance, in the lungs. From these distant lesions the bacilli get into the blood stream and are carried to various parts of the body, frequently to the fallopian tubes. In some cases the fallopian tube lesions constitute the only secondary lesion found.

2. Tuberculous lesions in adjacent organs, as the bladder, rectum, intestines, or abdominal peritoneum. Occasionally these penetrate deeply into the tubal wall and become so extensive that the tubal lesion is an important item in the situation, in which case the term tubal tuberculosis may be reasonably applied to designate the pelvic part of the picture. Two foci to be kept in mind in this connection are tuberculous ulcers of the intestine and tuberculous appendicitis.

Fig. 930 – Peritoneal tuberculosis (Kelly—*Operative Gynecology*.)

3. In some cases the tuberculous infection may come by way of the genital tract from lesions lower—for example, from tuberculosis of the uterus, though presumably extension is usually from above downward.

Pathology

Three forms of intratubal tuberculosis are recognized—(a) miliary tuberculosis of the mucosa, (b) chronic fibroid tuberculosis, and (c) chronic diffuse tuberculosis.

a. Miliary tuberculosis of a fallopian tube presents the same characteristics as miliary tuberculosis of other mucous membranes—that is, there are fine tubercles scattered beneath the epithelium and not yet broken down. Owing to the structure of the tube, the miliary tubercles readily escape observation unless the removed tube is examined microscopically. This form of tuberculosis may give rise to but few symptoms, and may cause so little disturbance that there is no suspicion of serious disease.

b. If these tubercles fail to pass on to the stage of caseation, but instead become surrounded by a large amount of connective tissue and pass into a quiescent state, we have the condition known as ''fibroid tuberculosis of the tube.'' The tube is somewhat thickened, hardened, and enlarged by the infiltration, but there is little or no breaking down of the lesions.

c. If, on the other hand, the tubercles progress to the stage of caseation and break down, there results the condition known as ''chronic diffuse tuberculosis of the tubes.'' The tube is disorganized and contains collections of caseous tuberculous material, as shown in Figs. 931 and 932.

The appearance of the tube varies, of course, with the severity of the disease. In advanced cases the tube is greatly enlarged and on cutting it open the yellow broken-down material is seen—the so called "caseous pus." This varies much in consistency, being in some cases rather thin and in others semisolid. When this is removed, the mucosa of the tube is seen to be studded with tubercles in all stages of breaking down, and there are also irregular, ragged ulcers, with small yellowish tubercles in their walls. Microscopic sections reveal giant cells lying in typical tubercles, as shown in Fig. 933.
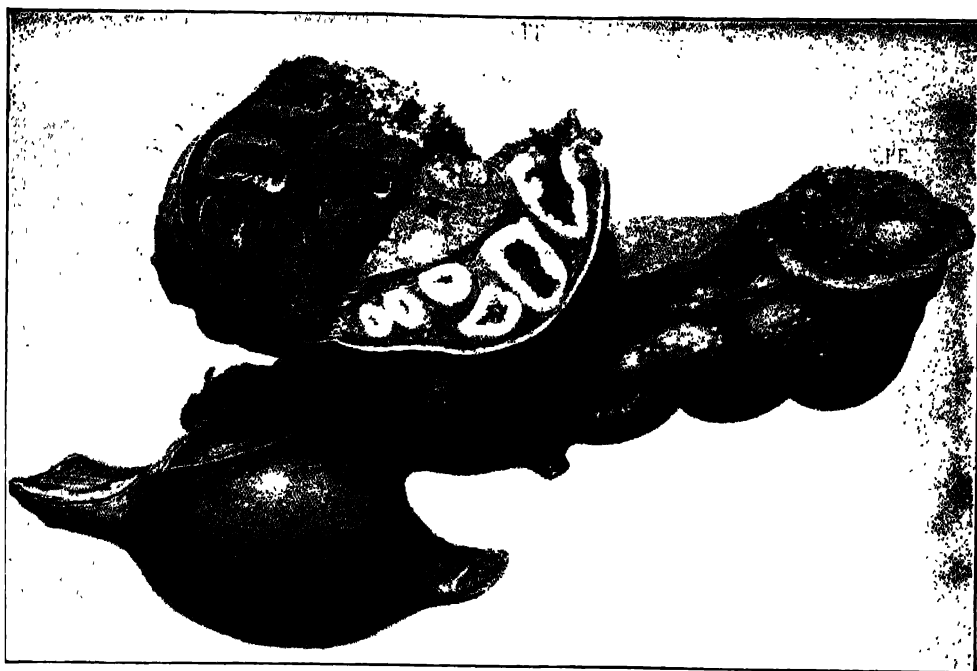
Fig. 931.—Tubal tuberculosis. (Kelly—*Operative Gynecology.*)

Fig. 932.—Tuberculosis of the tube. The tubal lumen is shown in the left half. Notice in the solid area near the center of the tube, some small grayish patches. These are tubercles. Gyn. Lab.

Macroscopically, in typical cases, small gray tubercles may be seen on the peritoneal surface and in the cut walls and mucosal folds. But in the early cases it is easy to mistake the condition for ordinary salpingitis. In carefully examined series of tubes at operations for salpingitis, tuberculosis was found in 10 to

15 per cent, but in only about one-fourth of these was it so marked as to be readily recognized. In the remaining cases it was found only by microscopic examination, and it may be missed even in the microscopic examination unless routine sections are made from different parts of the tubes.

On the other hand, there is occasionally seen a condition known as **pseudo-tuberculosis** of the peritoneum in which the tubal surface may be studded with small opaque thickened spots presenting the appearance of peritoneal tubercu-losis. Microscopic examination of the involved tissue, however, shows no tuberculosis, but simply chronic inflammatory infiltration.
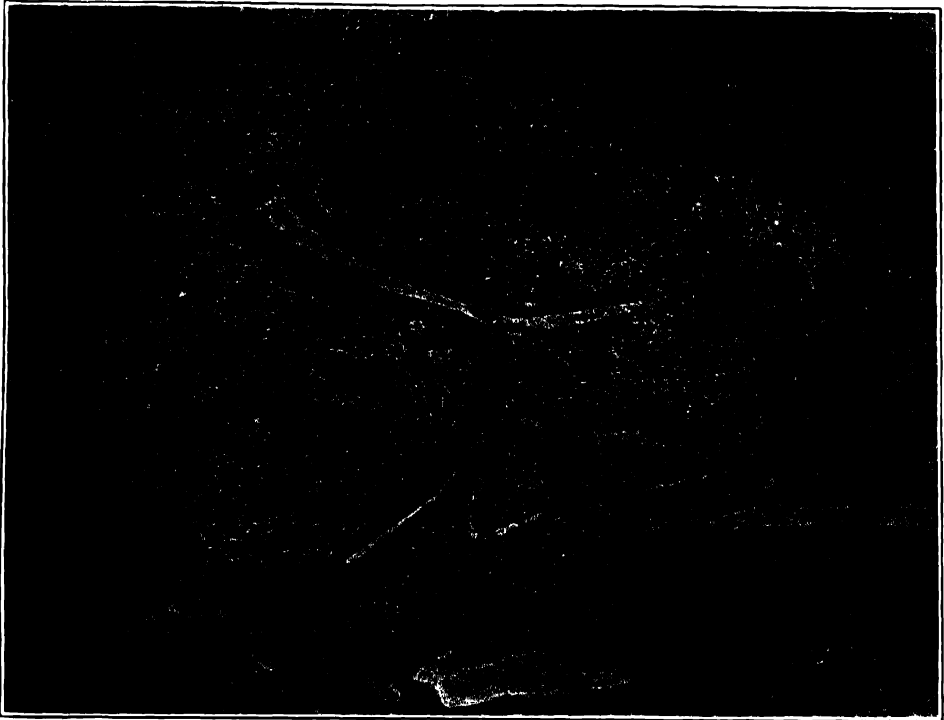
Fig. 933.—Tuberculosis of the tube. High power of the specimen shown in Fig. 932. Notice the typical tubercles containing giant cells. Gyn. Lab.

Denton and Dalldorf called attention to very confusing pseudotuberculosis lesions deep in the tube wall and presented an extended discussion of the pathol-ogy. They conclude that it is a "foreign-body salpingitis," and state that in the investigation of their pathological material they found several diagnosed as tubal tuberculosis. They suggest careful investigation for it in all cases of supposed tubal tuberculosis which present atypical microscopic pictures, and checking by bacteriologic staining and cultures.

Symptoms and Diagnosis

The symptoms of pelvic tuberculosis are much the same as those of chronic pelvic inflammation. In fact, it is a pelvic inflammation of a special kind. In a large percentage of the cases the diagnosis of tuberculosis is made only after the abdomen has been opened, the operation having been undertaken for what was supposed to be ordinary pelvic inflammation.

In not a few cases, however, a positive diagnosis of tuberculosis is possible before operation, and in some cases it is easy.

The conditions that point to pelvic tuberculosis are as follows:

1. Symptoms of chronic pelvic inflammation in a girl or young woman who has had no evidence of uterine infection.

2. Gradual onset without previous uterine disease, and persistent progress without the periods of marked improvement usually present in ordinary pelvic inflammation.

3. Emaciation, gradual and persistent, without a corresponding severity of the inflammatory trouble.

4. Evidences of tuberculosis elsewhere. Most cases of pelvic tuberculosis occur in patients having pulmonary or intestinal tuberculosis.

5. Tuberculin reaction. In a doubtful case this may aid materially in the diagnosis.

King reviews the subject of pelvic tuberculosis and states the following in regard to tests:

There are three tests that have been extensively used and certain facts concerning them should be known even by those not especially interested in pulmonary tuberculosis. When Koch developed his "old tuberculin" it was used as a diagnostic agent and also as a "cure" for tuberculosis. Its use as a cure was quickly abandoned, and it was finally used only in diagnosis by means of the Pirquet scratch test. This proved to be somewhat crude. It was sufficiently definite, but was not a quantitative test. The Mantoux test is at present the one most frequently employed. It is used intradermally and its advantage lies in the possibility of accurately determining the amount of tuberculin to which the individual will react. It may be used in varying dosage. A 0.001 mg. dose will usually elicit a reaction to an active tuberculosis. Should it not, a 0.01 mg. dose may be tried, reaction to which will always indicate the presence of tuberculosis.

A still more recent test is the use of purified protein derivative, the so-called "P. P. D." test. It is supplied in one-fourth grain tablets of two strengths, 0.0002 mg. and 0.05 mg. These tablets are soluble in the salt solution supplied with them, and varying strengths can thus be prepared. Incidentally, it is of interest to note that during the two-year period from June, 1934 to June 1936, 56,688 individuals were tested with purified protein derivative, and positive reactions were found in 47 per cent. This is a marked decrease from the 70 to 80 per cent of a few years ago. Purified protein derivative will doubtless be the choice for future tests for tuberculosis. It is intradermal and possesses all the advantages and none of the disadvantages, such as sensitization, of the other tests.

About the time Löwenstein reported his blood cultures, he proposed a skin test. It consists of the soluble substance of the tubercle bacillus, extracted with glycerine, and the whole dead bacillus. The skin is cleansed and a drop of this testing agent is rubbed in. A positive reaction consists of a nodule at the site of the inunction. In a reactor, the nodule will appear in from twenty-four to seventy-two hours. This test is not as delicate as the Mantoux and Pirquet tests. Fine, who did a comparative study of the three tests, concluded that, while the Löwenstein test is not as delicate as the other two tests, a reactor to it is certain to have an active tuberculosis and in his opinion it qualifies that individual for sanitarium treatment. Is it possible that such a test, being less sensitive, would be of greater value in surgical tuberculosis than the more sensitive ones?

Treatment

If there are no contraindicating lesions elsewhere, the affected tubes should be extirpated, preferably by abdominal section. The operation should be preceded and followed by antituberculous remedies and regimen. X-ray treatment is worthy of trial.

If there are marked lesions elsewhere, or if the local trouble has advanced too far for radical operation, palliative measures are indicated—anti-tuberculosis remedies and the employment of the various other measures found useful in tuberculosis elsewhere.

In some cases of extensive peritoneal tuberculosis, cure has followed simple abdominal section. However, in operating for tubal tuberculosis, removal of the tubes is advisable whenever practicable, and in some cases the uterus and ovaries also should be removed. Supravaginal hysterectomy is the preferable type in such a case, as the cervix is rarely involved and also this reduces the chance of tuberculous sinus into the vagina. The uterus is involved in about 50 per cent of the cases of tubal tuberculosis, and the ovaries are likely to be involved from close proximity. Also, continued ovarian activity might favor extension of any remaining foci.

In a young woman, however, the matter of continuing ovarian activity is to be carefully considered pro and con along with the other circumstances of the case. The many complete recoveries from extensive peritoneal tuberculosis after simply opening the abdomen gives reasonable hope of recovery from remaining foci after removal of the tubes when they harbor the main lesion. It is to be remembered also that if the continued ovarian activity and recurring menstruation should later seem undesirable in that case, they may be easily stopped by x-ray treatment. On the other hand, in or near the menopause age radical operation by removal of the uterus and ovaries along with the tuberculous tubes is indicated when the abdomen is opened.

Jameson in his monograph on *Pelvic Tuberculosis* includes the following items in his summary:

The end-results of surgery followed by roentgen radiation, as advocated by Edling, Wetterdal, and others, appear to be an improvement over those of either method alone.

Accurate diagnosis is essential before roentgen-rays are to be used and exploratory laparotomy with or without excision of tissue for microscopic examination is usually necessary.

Collections of purulent material are not influenced by the roentgen rays and must be drained surgically.

According to Baer the following types of cases should be radiated: (*a*) Cases with co-existent active tuberculosis of other organs, particularly of the lungs; (*b*) all cases of adnexal tuberculosis in which the diagnosis is certain; (*c*) cachectic cases which cannot be operated for diagnosis or which refuse operation. (The use of roentgen rays in cases with uncertain diagnosis should be deprecated and is contraindicated without exploratory laparotomy—E. M. J.) (*d*) All radically or incompletely operated cases (prophylactic after-irradiation); (*e*) all cases in which a relapse has occurred; (*f*) all cases of adnexal tuberculosis associated with an adhesive peritoneal tuberculosis.

King employs tube drainage when pus is encountered in operating for pelvic tuberculosis. He states that sinuses will heal under conservative measures, and that operation is rarely required for them. He emphasizes the value of sanatorium treatment and heliotherapy, and is firmly convinced that they should be employed in every case of pelvic tuberculosis, regardless of how successful the surgery may have been.

TUMORS OF FALLOPIAN TUBES

New growths of the tube are rare. They include the ordinary types of benign and malignant tumor formation.

Benign Tumors

There are several types of cysts occasionally seen in the tube—endometrial or endosalpingeal. The hydatid of Morgagni is usually seen as a small cyst
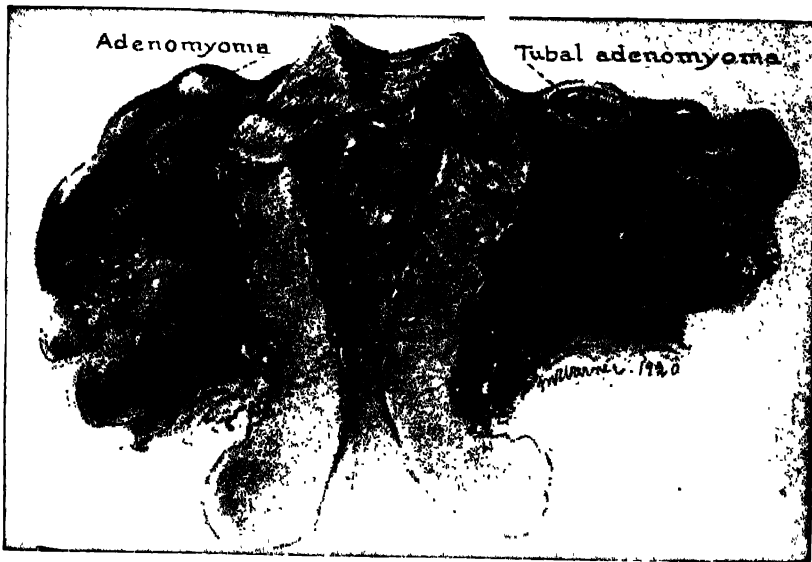
Fig. 934.—Adenomyomas of the fallopian tubes. (Hahle—*Surg., Gynec. and Obst.*)

A. B. C.
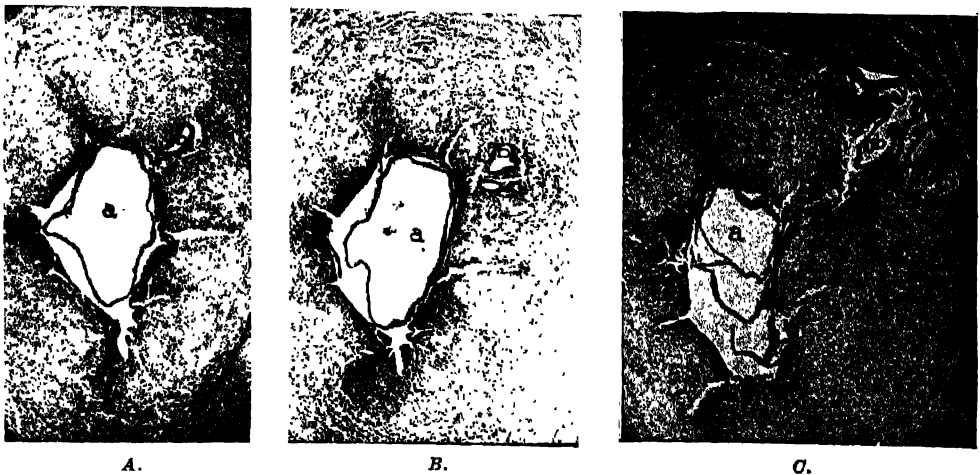
Fig. 935.—Demonstrating origin of a tubal adenomyoma from the tubal mucosa, by serial sections. *A, B, C,* Rather widely separated sections, showing the mucosal glands at different stages of outward growth. (Mahle—*Surg., Gynec. and Obst.*)

at the fimbriated end of the tube, and rarely an accessory tube is found attached to the normal tube as a cystic mass. These cysts are nearly always small. The hydatid of Morgagni is lined with low cuboidal epithelium. The
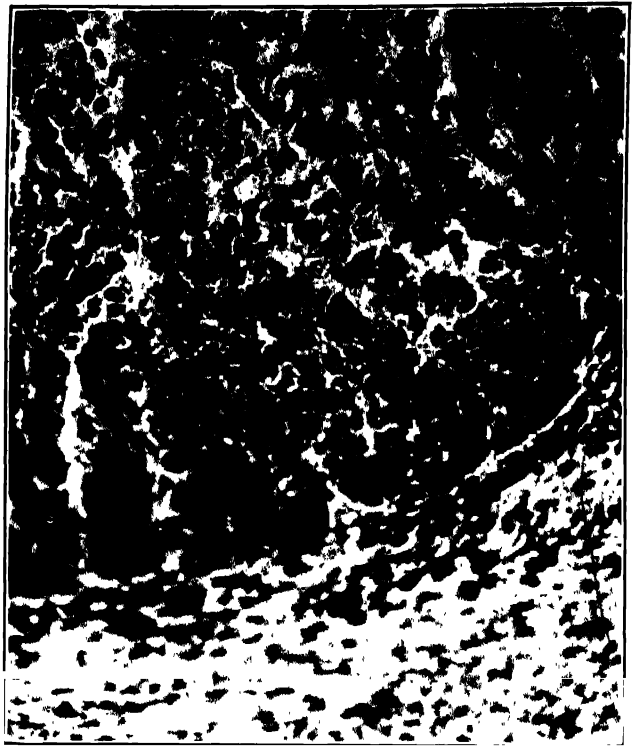
A.   B.

Fig. 936.—Carcinoma of the tube. A, Low power. B, High power to show the character of the cells. Gyn. Lab.

A.   B.

Fig. 937.—Sarcoma of the fallopian tube secondary to a sarcoma originating in a uterine myoma. A, Low power showing the sarcomatous infiltration of the tubal mucosa. B, High power showing the form and distribution of the sarcoma cells. Gyn. Lab.

accessory tubes are lined with tubal epithelium, and the endometrial cysts have been described under similar cysts in the ovary.

The other benign tumors of the tube are solid tumors. The most common is the adenomyoma. Fig. 934 shows adenomyosis of the tubes, and Fig. 935 indicates one method of origin. Other types of tumor in this situation are so rare as to require mere mention—fibroma, lipoma, osteoma, dermoid, lymphangioma.

Malignant Tumors

Carcinoma.—Primary carcinoma of the fallopian tube is very infrequent. Vest, in 19,000 gynecologic cases, found four carcinomas of the tube. It occurs in only about 1 per cent of operations for tubal affections. It is bilateral in approximately one-third of the cases.

The most frequent age incidence is between forty and fifty years. Preceding chronic tubal infection is the most important single etiologic factor.

The carcinoma occurs most frequently in the middle and outer thirds of the tube. The tube appears as a sausage-shaped tumor. In the early cases the surface is smooth with few adhesions, but in the more advanced cases the surface is nodular and covered by adhesions. On sectioning the tube, the lumen is found to be filled with soft, friable, papillary projections. In the more rapidly growing carcinomas the tissue has a solid brainlike appearance. Rupture is frequent and this causes dense adhesions due to the attempt at walling off.

The papillary **carcinoma** (Fig. 936) shows a multilayered polymorphous epithelium on a fibrous network. In the more malignant types, the papillae are so closely packed that the growth appears to be solid. Occasionally they have a glandular appearance, resembling adenocarcinoma of the uterus.

Sarcoma.—Only about 10 cases of proved tubal **sarcoma** have been reported. They present the ordinary characteristics of sarcoma, and may be spindle cell, round cell or polymorphous, with giant cells present. Sarcoma of the tube is shown in Fig. 937.

Secondary carcinoma or sarcoma may occur, and is usually due to direct extension from some nearby organ.

If arising from the interstitial portion of the tube, they produce the symptoms of similar tumors of the uterus. If arising from the outer portion of the tube, they correspond in position to tumors of the ovary.

It is interesting to note that chorioepithelioma has been found in a tube following tubal pregnancy.

The diagnosis of tumors of the tube is usually made after the abdomen is opened. They present no definite distinguishing characteristics, and when felt in examination are usually taken for growths arising from those structures in which tumors more frequently occur; namely, the uterus, the ovary, or the broad ligament.

The treatment for tumors of the tube is removal when circumstances permit.

TORSION OF ADNEXA

Torsion of the approximately normal tube and ovary occurs occasionally giving rise to attack of pain in that region. Smith reviewed the **subject**,

detailing and analyzing the reported cases. Anything which increases the size and weight of the adnexa favors the development of a twist in the narrow portion joining the uterus. In some cases the torsion comes and goes, the relations of the structures evidently changing with the positions of the patient and probably with the swelling of the parts. A patient with this condition will have intermittent pains difficult to account for. Fig. 938 shows the condition found in a patient operated on by the senior author for a small adnexal mass with attacks of pain which would come and go without apparent cause. Fig. 939 shows the specimen with the torsion untwisted.

VARICOSE VEINS OF BROAD LIGAMENT

Occasionally the veins of the broad ligament are found markedly varicose, as shown in Fig. 940, and in the dilated veins are sometimes found thrombi and even small stones (phleboliths).

The principal etiologic factors of these varicosities are subinvolution of the broad ligaments following pregnancy, relaxation of the tissues from poor general health, and obstruction of the venous circulation of the broad ligament by tumors or heart disease or loaded bowel or uterine displacement.
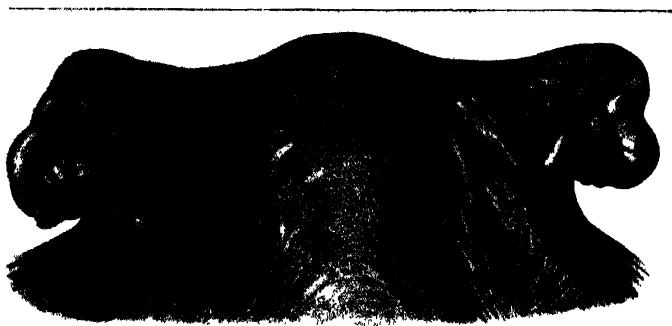
Fig. 940 —Thrombosed veins of the broad ligament. (Schaeffer—*Hand-Atlas of Gynecology.*)

The symptoms (weight and pressure when upright, relieved by the recumbent posture) are not distinctive—in fact, the condition is usually overshadowed by more evident lesions. In most cases so far reported this condition was thought of only after the abdomen was opened and the enlarged veins were apparent.

In cases of persistent pelvic pain without palpable lesion this condition should be considered, and if the symptoms are severe in spite of palliative measures it may be advisable to make an exploratory abdominal section, with the idea of correcting this condition if found.

When phleboliths of thrombi are present, they may produce enough induration to be appreciated on bimanual palpation. If phleboliths show in an x-ray plate, they may be mistaken for ureteral or bladder calculi or for myoma calcification. The treatment of varicose broad-ligament veins found at operation should be adjusted to the particular conditions present in that case. Very often the ovary or tube on that side needs removal for some condition, and its removal and the resulting ligation take care also of the varicose veins.
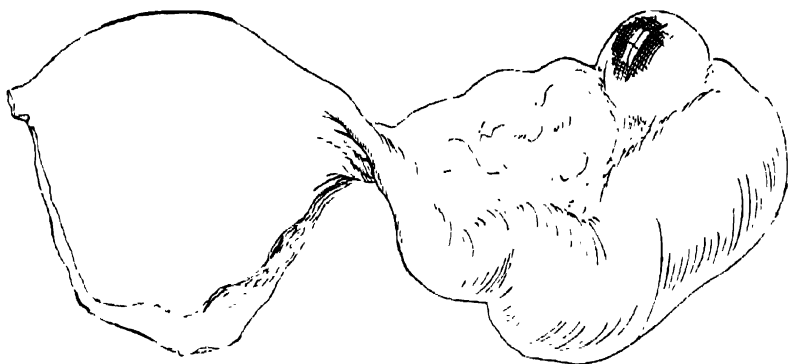
Fig. 938.

Fig. 939.

Figs. 938 and 939.—Hydrosalpinx with Torsion of Pedicle. Patient had intermittent attacks of pain, with complete subsidence between attacks. The recurring pains were evidently due to recurring moderate torsion, with resulting circulatory disturbance and temporary acute swelling. The intermittent torsion was not severe enough to block the circulation and cause thrombosis (as in the specimens shown in Figs. 1019 and 1020). Fig. 938 shows the twist in the pedicle. In Fig. 939 the twist has been untwisted, showing the constriction of tissue at the site of the torsion and the swelling of the structures distal to it. Colored drawing from fresh specimen. (Crossen and Crossen—*Operative Gynecology*, The C. V. Mosby Company.)

MISCELLANEOUS RARE CONDITIONS

The miscellaneous conditions, found in the pelvis less frequently, will be considered in the following order: brucellosis, actinomycosis and blastomycosis, trichomoniasis, lymphogranuloma, echinococcus disease, metastatic cancer nodules in the cul-de-sac, retroperitoneal masses, and foreign bodies.

Brucellosis.—This disease, due to bacteria of the brucella group and known in somewhat different forms as undulant fever, tularemia, rabbit disease, Malta fever, etc., is likely to be overlooked as a cause of pelvic lesions, because pelvic localization is infrequent. The authors recall one such case that was very puzzling, with the attacks of disability and fever and pelvic exudate coming and going without apparent cause. Finally, suspicion of brucellosis was aroused, and tests showed that disease.

The pelvic lesions consisted of masses of exudate, as in subacute inflammation, but without traceable evidence of pelvic infection from labor, miscarriage, instrumentation, gonorrhea, or tuberculosis. Effective treatment proved a difficult problem. Fever therapy was an important factor in the final control of the recurrent attacks.

Actinomycosis and **Blastomycosis.**—*Actinomycosis* is occasionally encountered in the pelvis. Auster gives the following summary regarding this disease, including its pelvic forms:

1. Human actinomycosis is a relatively infrequent but wide-spread disease which is prevalent more particularly in grain-producing areas of the United States.

2. The causative organism is an anaerobe of specific morphological, cultural and serological character.

3. The pathologic picture is characterized by long-standing productive inflammation associated with liquefaction necrosis and draining sinuses, although diagnosis is frequently obscured by intercurrent infection.

4. The clinical course is that of a wasting infectious process, similar to tuberculosis, with bizarre symptomatology depending upon the organs involved or the anatomical location of the disease. No tissue is immune.

5. The abdominal form is usually ileocecal in origin, and in its early state presents a clinical picture similar to acute appendicitis, ileocecal tuberculosis, or nonspecific intestinal granulomatosis. It may be associated with bacillary dysentery.

6. The genito-pelvic type is more common in females and may occur by direct infection of the pelvic generative organs without prior intestinal involvement.

7. Dissemination of the disease, while showing metastatic (probably hematogenous) involvement of the liver, occurs by direct extension to neighboring organs with the production of mural intestinal lesions rather than by lymphatic drainage pathways. Lymph node involvement is usually the result of secondary infection by bacterial invaders from the intestine or skin wounds. Peritonitis is a frequent complication.

8. Four illustrative cases are presented showing varying forms of the disease with particular reference to the abdominal and genito-pelvic forms, of which one case each is reported in detail with postmortem findings. No apparent source of infection was determined.

9. Mortality, in types other than the cervico-facial form, has been unusually high on account of lack of effective therapeutic measures.

10. Best results in the treatment of actinomycosis, at this time, probably may be obtained by combined therapy including the use of surgery, high-voltage x-ray treatment, and both local and systemic administration of thymol.

Dobson, Holman and Cutting report on the use of sulfanilamide in the therapy of actinomycosis.

Joseph and Summerill report invasion of the tubes by yeast fungus, and show the *blastomyces* cultured from a suppurating tube. They feel that pelvic mycosis in different forms occurs more frequently than generally appreciated.

Trichomoniasis.—The *Trichomonas vaginalis* has been found in the uterus and tubes and peritoneal cavity, as mentioned under Trichomonas Vaginitis in Chapter IV.

Lymphogranuloma.—Lymphogranuloma inguinale may appear in the fallopian tubes. D'Aunoy and Schenken report a case in which the ordinary symptoms of chronic pelvic inflammation and tender adnexa were the only clinical findings. Inspection of the tubes after removal gave the impression of nodular salpingitis. The microscopic check-up revealed a suspicious histologic structure. Frei tests were then made with two different antigens, and the reaction was strongly positive with each.

Echinococcus Disease.—Echinococcus invasion of the pelvis comes from the intestinal tract. After digestion of their covering, the embryos are released and penetrate the bowel wall into the surrounding tissues. They may enter the blood stream and be carried to liver and lungs or remain and grow locally, forming small cysts. When the disease affects the pelvic organs, it is supposed to come by penetration of the rectal walls. When a cyst breaks into the pelvic peritoneal cavity, that liberates the scoleces, which attach themselves to the peritoneum. They may penetrate into the subperitoneal tissues, forming echinococcus cysts there and then penetrate on into the organs including the uterus (see Echinococcus Disease of Uterus).

Metastatic Cancer Nodules in Cul-de-sac.—Ordinarily when a small hard mass is felt in the posterior peritoneal cul-de-sac it is assumed to be old inflammatory exudate or endometrial implantation. In older women, however, gravitational cancer implantation, from gastrointestinal or other growths higher in the abdomen, must be kept in mind. The Krukenberg tumor is not the only type of growth representing metastasis from higher abdominal areas to the pelvis. Bacon has called attention to such extrarectal masses felt in the peritoneal cul-de-sac area in the male, as an indication of cancer higher, and illustrates the examination findings instructively, as shown in Fig. 941.

Retroperitoneal Masses.—The difficulties of pelvic diagnosis are greatly increased by retroperitoneal masses, which may simulate more common lesions to some extent. Such a mass may be a new growth from connective tissue or from some structure along the pelvic wall or it may be an ectopic organ, congenitally displaced to the pelvis. These conditions are comparatively rare and hence are likely to be overlooked when considering the probabilities and possibilities in a case. Though the commoner lesions must of course come first in diagnosis, an atypical clinical picture calls for careful consideration of these rarer lesions, particularly before tackling the mass for operative removal. Such preoperative consideration, with its looking-up of anatomical points and possible distortions, may prove of material assistance when, with the abdomen open, one is trying to determine relations and connections and the safest plan **of attack.**

J. R. Miller presents an instructive article calling attention to growths and other masses arising from the various organs and structures, and gives details of illustrative cases. There are many reports of retroperitoneal growths and deceptive masses, but the conditions are so varied that the result of an attempt at systematic classification is not satisfactory. However, the arrangement of the following list and the accompanying illustrations may aid in recalling diagnostic pitfalls to be avoided.

Connective Tissue.—In the connective tissue and contained structures there may arise various tumors, including lipoma, fibroma, myoma, adenomyoma, lymphangioma, hemangioma, and sarcoma. Also, inflammatory masses here may be bizarre in symptoms and in examination findings, particularly psoas abscess from tuberculosis of the spine.

Fig. 941.—Sagittal section, showing the tip of the finger between the prostate and a growth in the cul-de-sac; *a,* suprascrosal mass and, *b,* subserosal mass. (Bacon—*J. A. M. A.*)

Pelvic Walls.—Varied types of tumors arising from bones, muscles, fasciae or nerves of the pelvic walls may grow into the cavity, with resulting confusion in diagnosis. The plain x-ray film, advisable in all atypical pelvic masses, will show bony growths and other opaque outlines, but for the greater difficulties encountered in other conditions differential diagnosis may require other special measures, including gastrointestinal x-ray series to determine possible connection with that tract or displacement of intestinal coils in a way to show the deep relations of the mass. Many bony growths have been reported.

Displaced Organs.—The several terms "ectopic kidney," "fused kidney," "horse-shoe kidney," and "pelvic kidney," indicate the attention and tragic interest forced by masses in the pelvis which proved to be of that character. It is hardly necessary to remark that such a condition should be absolutely excluded

before an uncertain mass is removed. Even prolapse of an otherwise normal kidney may carry it to the pelvis where it may at first be mistaken for an adnexal mass.

The kidney is not the only abdominal organ that occasionally appears in the pelvis. A spleen has been dug out of adhesions beside the uterus and removed under the impression that it was a degenerating fibroid.

Foreign Bodies.—A foreign body in the pelvis excites inflammatory reaction or encapsulating exudate, forming a mass which is replete with possibilities for diagnostic error. Being a very unusual condition it is rarely thought of, until some incidental finding excites suspicion or operative removal reveals its character.

Fig. 942.—X-ray film showing a catheter in the peritoneal cavity. It had been there since an abortion twenty-six years before. (Hill—*J. Missouri M. A.*)

Attempts at abortion are responsible for a large proportion of the foreign bodies in the pelvis. Fig. 942 shows an interesting case of this kind. The many reported cases of a foreign body left at operation and found unexpectedly in a removed mass, months or years afterward, should cause consideration of this possibility in all obscure abdominal conditions and lead to appropriate diagnostic investigation. Figs. 943 and 944 show types of such cases.

A swallowed body (often swallowed without the patient knowing it) may lodge in the intestine and gradually work out into the surrounding tissues and cause a pelvic inflammatory mass. This mass may simulate ordinary pelvic

Fig. 943.—Encapsulated sponge removed after fourteen years The capsule has been opened, and the mesh of the gauze is clearly seen. (Watson and Desnoes—*J. A. M. A.*)

Fig. 944.—X-ray film showing a forceps (hemostat) in the abdomen four years after an abdominal operation. The patient was supposed to have a tumor, till x-ray examination revealed the forceps. (Crossen—*Foreign Bodies Left in Abdomen.*)

inflammation, and be operated on as such. The intestinal connection adds a dangerous complication, which should be known before operation so that it could be taken into consideration in making the decision as to operation and in arranging for the technical details of the work. Hence the advisability of x-ray examination in all atypical abdominal conditions, to obtain all information possible before deciding on type of treatment.

An instructive case of this type was a patient sent to the senior author in 1933 for a pelvic inflammatory mass. The mass involved the right tubal region but also extended higher, giving the impression of possible appendiceal complication, so she was sent for x-ray examination. This revealed an open safety pin which had perforated the cecum and formed an inflammatory mass lower. The patient was fifty-five years of age, had had no abdominal operation and had never swallowed a pin as far as she knew. It was probably swallowed unnoticed when her children were small and required the daily handling of safety pins. Her youngest child was nineteen, and the patient had noticed trouble in that side off and on for at least that many years—not severe, but uncomfortable and annoying. She was partially disabled at times and had to rest a few days, but otherwise worked right along.

Operation was advised, but not urged. The foreign body was apparently well encapsulated and could be carried with little danger of sudden serious development. The patient decided she did not wish operation, unless the symptoms should become more marked. Lateral films were made, along with anteroposterior ones, for accurate localization, in case operation should become necessary any time. The patient was instructed to report periodically for check-up, and to come immediately if there should be any marked disturbance. A check-up film made in 1939, six years after the first one, showed the safety pin in the same location. There have been no marked symptoms.

In another of our cases, an x-ray film (made on account of persistent pelvic neuralgia without apparent cause) revealed an ordinary pin, which had evidently worked out of the intestine and become fixed in the center of the left side of the pelvic cavity.

The subject of foreign bodies left in the abdomen at operation and otherwise, with symptoms and methods of examination and treatment and prevention, has been considered in detail by the senior author in a recent monograph (Foreign Bodies Left in the Abdomen), and Figs. 942 to 944 are from that work.

DISEASES OF THE OVARY AND PAROVARIUM

Tumors constitute the principal lesions occurring in the ovary, and of these about 95 per cent are cystic. There occur also infections, mostly secondary inflammation, and endocrine disturbances with important functional and structural results.

Classification of Diseases of Ovary and Parovarium

PROLAPSE OF OVARY AND CIRCULATORY CHANGES.

INFECTIONS { Inflammation (gonococcus, streptococcus, staphylococcus, colon bacillus)
{ Tuberculosis, Syphilis, and Rarer Infections

DISTURBANCES OF FOLLICULAR FUNCTION { Follicular Atresia
{ Follicular Cysts ("cystic ovary")
{ Corpus Luteum Cysts

EMBRYOLOGIC RESTS

Undifferentiated Sex Cells — Endocrine Influence { Feminizing } Granulosa-Cell Tumor
{ Masculinizing } Arrhenoblastoma / Adrenal Adenoma

No Endocrine Influence { Dysgerminoma (Seminoma)
{ Brenner Tumor
{ Hypernephroma

Undifferentiated Somatic Cells { Dermoid Cyst
{ Teratoma

Embryologic Remnants { Parovarian Cyst
{ Gaertner's Duct Tumor

TRANSPLANTATION OR HETEROPLASIA OR EMBRYOLOGIC RESTS { Endometrial Cyst
{ Pelvic Endometriosis
{ Adenomyoma

CHANGES DEPENDENT ON ENDOCRINE DISTURBANCES IN DISTANT ORGANS

Theca-Lutein Cysts { Hydatidiform Mole of Uterus
{ Chorioepithelioma of Uterus
{ Adenoma of Pituitary

Follicular Atrophy { Adrenal Adenoma
{ Adrenal Hyperplasia
{ Pituitary Atrophy (by tumor or otherwise)

OTHER BENIGN GROWTHS { Proliferating Cysts { Pseudomucinous Cyst
{ Serous Cyst (Papillary Cyst)
{ Solid Growths { Fibroma
{ Myoma and Adenomyoma

MISCELLANEOUS RARE TUMORS { Lymphangioma
{ Mesonephroma
{ Ganglioneuroma

OVARIAN CANCERS { Carcinoma { Primary
{ Secondary
{ Sarcoma { Primary
{ Secondary

Satisfactory classification of ovarian pathologic changes has long been one of the problems of systematic gynecologic teaching. The reason for this lies in the complexity of the organ's structure and physiology and the resulting

complexity of its pathologic activities. The principal difficulty is with the great variety of benign growths and near-growths, some of which are real neoplasms and others only retention cysts.

It is hoped that the above working classification may help some toward clarifying the situation. In classifying these pathologic changes it seemed best to base the classification on *cause*, as far as the cause is known. This brings at once to the student a rational grouping of the confusing variety of pathologic changes with which he must deal. Also, it puts him in touch promptly with the etiologic factor, which is one of the first items to be considered in connection with any lesion, and which is also usually helpful in understanding the microscopic picture and the clinical progress.

PROLAPSE OF OVARY

A large heavy ovary is likely to sink low in the pelvis, especially if its supporting attachments are weakened through subinvolution after labor or through congenital deficiency. The enlargement is often due to the formation of numerous follicular cysts, giving the enlarged "cystic ovary" described later.

Prolapse of the ovary does not ordinarily become of clinical importance unless it drops into the peritoneal cul-de-sac back of the uterus. In this situation it may give rise to pressure symptoms, especially during the menstrual congestion or at the time of ovulation. The principal disturbance comes in those cases in which the ovary becomes adherent in this location, and cannot move on pressure as it normally does.

In most cases giving trouble, the principal complaint is dyspareunia, with the discomfort located high inside rather than at the vaginal entrance. Occasionally there is pain on bowel movement or pressure discomfort when the rectum is filled. In some retrodisplacement cases, the ovary is found low in the cul-de-sac under the corpus uteri, and the disturbance from its fixation there may furnish the principal symptoms.

As to treatment, there may be prolapse and fixation of one or both ovaries without any symptoms. Consequently, when the condition is found in the course of an examination, question the patient carefully to determine if there are symptoms due to it before disturbing her with knowledge of its presence.

When there are troublesome symptoms, the knee-chest posture may aid by gravitating the tender ovary out of the cul-de-sac or by lessening circulatory disturbance in it. If movable and pushed out of the cul-de-sac during examination, it may stay in the improved position. Occasionally a retrodisplacement pessary will keep it up out of the way comfortably.

If the ovary is adherent, it may be possible to stretch light adhesions by digital pressure or by use of the mercury pressure bag. If there is persistent discomfort despite conservative measures, operation is advisable to correct the painful condition. Very often there are more important associated lesions requiring operation, and the prolapsed ovary is taken care of incidentally, by removal or fixation, as conditions indicate.

Circulatory Changes

Interference with the circulation to the ovary causes it to become edematous and occasionally cystic. Retrodisplacement of the uterus, with a consequent prolapse of the ovaries, is a common etiologic factor in this condition. Other causes are pressure on the vessels by tumors of other organs, varicose veins, a chronic twist in the pedicle not sufficient to cause a gangrenous ovary, and trauma (operative or otherwise). These ovaries are usually a little larger than normal, and the chief microscopic finding is edema and chronic passive congestion.

INFECTION OF THE OVARY

Infections include inflammation which may be due to contagious disease or to ordinary pus bacteria (gonococcus, streptococcus, staphylococcus, colon bacilli), and tuberculosis and syphilis.

Inflammation of the ovary is usually secondary to salpingitis or other adjacent inflammation. There may be one or more points of infection with the usual infiltration and swelling—the inflammation involving both the follicles and the interfollicular connective tissue. It may or may not progress to the stage of abscess formation. When an ovarian abscess forms, it is usually in connection with tubal suppuration, hence it was considered along with salpingitis.

The ovary, instead of becoming infected, may simply become surrounded by exudate, which compresses it, damaging it and causing cellular infiltration of the connective tissue (both the capsule and stroma). In time this round-celled infiltration forms scar tissue, and as it contracts it further interferes with the graafian follicles, so that they atrophy or form small cysts. From this process the functionating part of the ovary becomes reduced in size, and the organ may come to consist simply of a mass of fibrous tissue with small cysts scattered through it. This condition is called cirrhosis, and ovaries thus affected are designated as "cirrhotic ovaries."

The other type of inflammation of the ovary is that in which the infection comes by way of the blood stream. This is seen at times in various general infectious diseases, particularly mumps and scarlet fever. The fact should be kept in mind that pelvic symptoms during the course of acute infectious diseases may be due to oophoritis, which may require additional rest and care during convalescence.

The pathologic findings are the same as those seen in acute inflammation elsewhere in the body. There is edema with dilated capillaries and leucocytic infiltration.

Chronic Inflammation.—The acute inflammation may resolve leaving no permanent damage or it may result in a chronic inflammation with adhesions and permanent damage to the tissue. The common finding in these cases is a mass composed of ovary, tube, and exudate, with or without abscess. In tubo-ovarian abscess either a tubal abscess ruptures into the ovary or an ovarian abscess ruptures into the tube and the two become fused. Microscopically there is a marked round cell infiltration. Later there may be destruction of the follicular apparatus and sclerosis of the remaining stroma.

Tuberculosis of Ovary

Tuberculosis of the ovary is almost always secondary to tuberculosis else-where. Direct extension is the usual method of infection, and it is commonly secondary to tubal tuberculosis. According to the statistics of Orthmann, in 307 cases of genital tuberculosis the ovary was involved in 33.9 per cent. In the gross the ovary is usually embedded in adhesions and studded with tubercles. In the late cases there are areas of caseation surrounded by thick, ragged walls. Cases of tuberculosis of the ovary associated with ovarian cysts have been reported.

Microscopically discrete tubercles are found in the superficial layers of the ovary. When a follicle or corpus luteum is involved, tubercles are found in the wall of the structure.

The symptoms and treatment are the same as for the more frequent tubal tuberculosis, the details of which are given in the preceding chapter.

Syphilis of Ovary

The protean manifestations of syphilis no doubt affect the ovary in struc-ture and function, and this is to be kept in mind when pelvic symptoms or disturbance appear in patients who have syphilis.

There are only a very few authentic cases of syphilis of the ovary in the literature. In the case reported by Gellhorn the gumma was centrally located, indicating its systemic origin. Microscopically it was a granulomatous mass containing a large number of plasma cells and eosinophiles.

DISTURBANCES OF FOLLICULAR FUNCTION

It is surprising how much structural change can be brought about in the ovary by mere disturbances of function. A slight misdirection of the endocrine influences which control normal ovulation may lead to follicular changes in the ovary of marked extent. The most common example of this marked structural change due to functional deficiency is "follicular atresia," in which the ovum dies and the follicle ceases growing and eventually shrivels. This occurs regu-larly on a large scale, for only a small percentage of the thousands of young follicles go on to maturity. Some of the follicles in which the ovum dies do not shrivel and disappear but fill with fluid which increases, resulting in the formation of small cysts (follicular cysts). Occasionally a corpus luteum in-stead of progressing normally will develop an increasing amount of fluid (corpus luteum cyst).

The above changes in the ovary occur without any causative lesion of other organs. Later, reference will be made to changes in the ovary brought about by lesions in other organs. Belonging to this class are the theca-lutein cysts, which may enlarge the ovaries till they fill the pelvis and lower abdomen, and follicular atrophy of the cortical functioning portion of the ovaries.

Follicular Cysts

Follicular cysts are simply unruptured graafian follicles which have be-come dilated. The increase in the fluid of the follicle and the consequent

formation of a small cyst are due to failure of the follicle to rupture. This failure to rupture may be caused by functional disturbance in the ovarian-pituitary endocrine cycle or it may be caused by mechanical difficulty due to deep situation or to thickening of the tunica albuginea or to peritoneal adhesions covering the surface of the ovary.
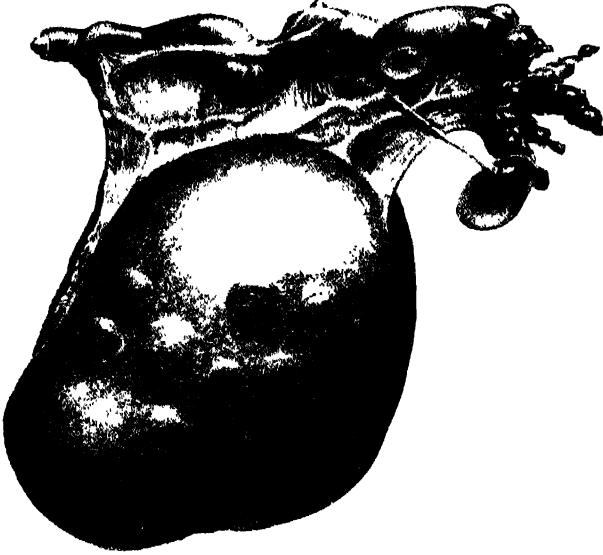
Fig. 945.
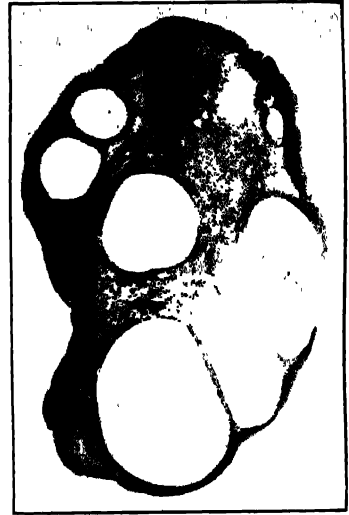
Fig. 946.

Fig. 945.—Follicular cysts of the ovary. (Kelly—*Operative Gynecology.*)
Fig. 946.—Polycystic ovary. Note that a major portion of the ovary is occupied by these follicle cysts. Gyn. Lab.
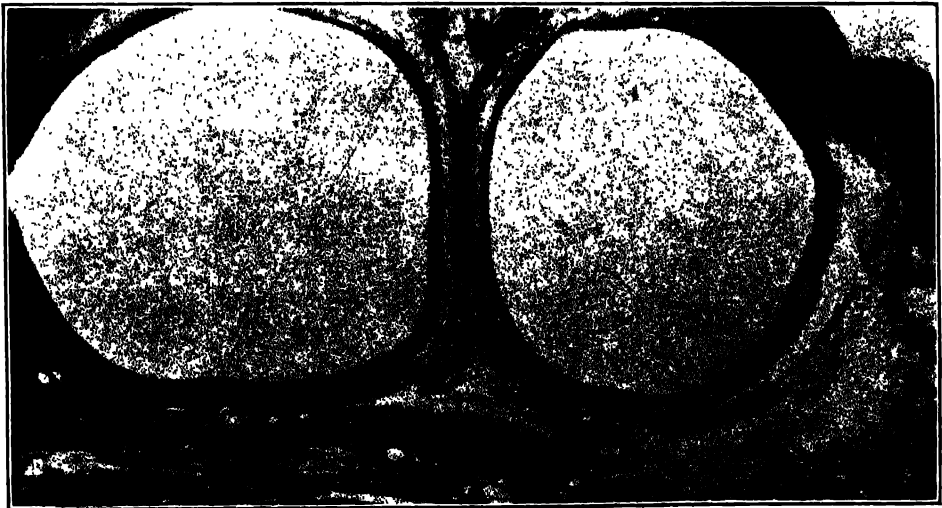
Fig. 947.—Polycystic ovary. Microscopic view of the upper cysts in Fig. 946. Note the lining of compressed granulosa cells. Gyn. Lab.

These cysts vary in size, the average size being that of a pea. When superficially placed the little cyst protrudes above the surface of the ovary as a translucent vesicle. In marked cases the ovary may be studded with these cysts. On cut surface they are usually seen in the cortex but occasionally are situated deeper. Sometimes there is a single large cyst.

The cyst wall consists of an outer fibrous layer containing blood vessels running parallel to the lining. In the younger cysts the lining may still show the granulosa-cell characteristics. In the larger older cysts the lining is usually missing; if present, it generally consists of a single layer of low cylindrical or cuboidal epithelial cells with central dark staining nuclei. Figs. 945 to 951 show the characteristics of follicular cysts.

Fig. 948.   Fig. 949.

Fig. 948.— Lining of follicular cyst shown in Fig. 947. The membrana granulosa may still be recognized though it is markedly compressed by the increased intracystic pressure. Gyn. Lab.

Fig. 949.—Lining of a larger follicular cyst. The membrana granulosa is thinned out due to pressure, and there is evidence of beginning disintegration. Gyn. Lab.
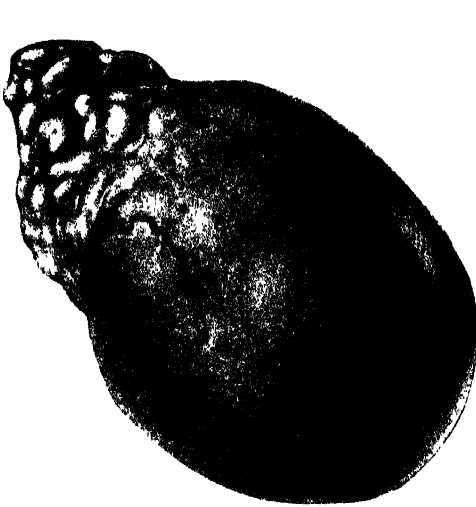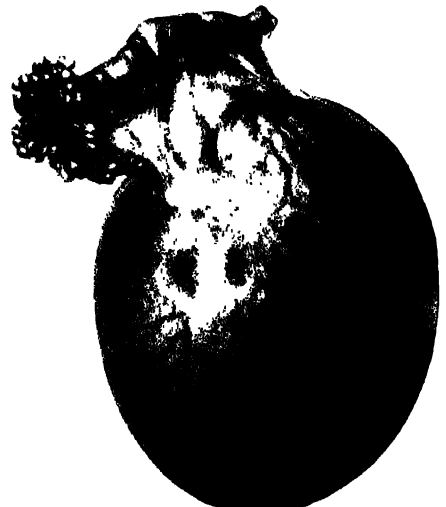
Fig. 950.   Fig. 951.

Fig. 950.—Single cyst leaving the larger portion of the ovary (left upper part in illustration) intact. Gyn. Lab.

Fig. 951.—In contrast to specimen shown in Fig. 950, this cyst formation involves the entire ovary, which had to be removed together with the tube. Gyn. Lab.

Symptoms and Treatment.—These follicular cysts are small and rarely produce serious symptoms. While a single cyst often involves only a part of the ovarian substance (Fig. 950), in other instances it may be found to affect the entire organ (Fig. 951). They are frequently found in chronic oophoritis, and an ovary may contain fifteen or twenty of them and still not be more than twice its normal size (Fig. 945).

Such a condition is designated by the term "hydrops folliculi" and also by the term "cystic ovary." This condition is not an indication for operation, unless there are serious complications or unusually severe symptoms. A marked cyst discovered in the course of an operation for some other pelvic lesion is ordinarily resected, with the minimum sacrifice of normal tissue.

The important point in treatment is to overcome the endocrine disturbance which interferes with ovulation and starts cyst formation.

In certain cases the failure to ovulate and the resulting cyst formation is due to old exudate or adhesions about the ovary or to thickening of the capsule.

Fig. 952.—A tuboovarian cyst. The arrow, passing in one window and out of the other, indicates the communication between the ovarian and the tubal portion of the cystic mass.

This is an important factor in some cases of sterility, and when other factors are eliminated, operation to remove the thickened capsule is to be considered. The diagnosis and treatment of sterility cases of this type are taken up in Chapter XV.

Tuboovarian Cyst.—A simple cyst of the ovary may break into an adherent tube, or a dilated tube containing fluid (hydrosalpinx) may become adherent to an ovary and break into it. In either case the wall of the resulting cavity is formed by both the tube and ovary, and the resulting cyst is designated "tuboovarian" (Fig. 952). These cysts are usually small.

Corpus Luteum Cysts

Corpus luteum cysts are, as their name indicates, derived from corpora lutea, which, instead of undergoing the regular process of absorption and cicatrization, undergo a cystic change. Microscopic examination of the wall of such a cyst will show the lutein cells, characteristic of the corpus luteum. Corpus luteum cysts are usually not larger than an egg, but cases have been

reported in which the cyst was the size of a child's head. In cut section the striking thing is the lining membrane which is brownish yellow or orange yellow, depending upon the amount of lutein and blood pigment present. The lining separates easily from the connective tissue wall. Figs. 953 and 954 show lutein cells in the wall of a corpus luteum cyst. In the older cysts there is sometimes only a single layer remaining. The cells are usually covered over on the cavity side by a thin layer of connective tissue, but this may be absent. Occasionally the lutein cells have disappeared, and in these cysts there is usually marked hyaline degeneration of the wall. The central cavity is sometimes filled with an old blood clot.

Fig. 953.
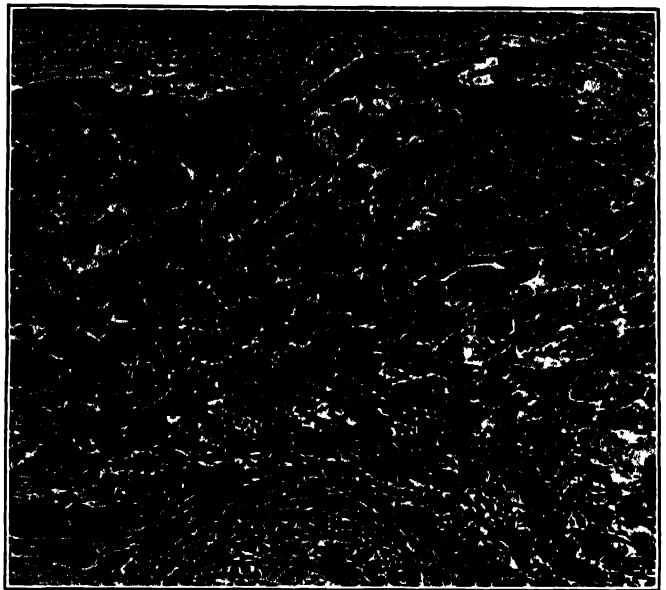
Fig. 954.

Fig. 953.—Section through wall of another corpus luteum cyst. Low power showing the cavity above, the three layers of the wall, and part of the surrounding ovarian stroma.

Fig. 954.—High power of Fig. 953, showing the lutein layer and the underlying theca interna and externa. Gyn. Lab.

Corpus luteum cysts, like follicular cysts, require removal only when giving trouble. It is possible that the luteum cells may multiply instead of degenerating, thus forming a neoplasm with exaggerated progesterone effect. Wheelon and Wilson reported a case of corpus luteum cystoma to which they attributed the patient's amenorrhea. But Novak questions the likelihood of the evanescent lutein cells alone forming a tumor. In discussing "luteoma" in connection with granulosa-cell tumors, he says that in most cases the so-called "luteoma" is really an adrenal adenoma of the ovary, the tendency of which is masculinizing rather than feminizing when it shows any definite endocrine effect.

EMBRYOLOGIC RESTS

In tumors developed from embryologic rests, three types may be distinguished, according to the character of the cells of the remnant from which the growth developed. Certain tumors develop from undifferentiated sex cells.

Some of these growths as they develop carry with them a certain amount of endocrine sex function—that is, they pour sex hormones into the system, in an erratic way and often with bizarre and striking results. The granulosa-cell tumor and the arrhenoblastoma belong to this class. Other tumors developed from undifferentiated sex cells seem devoid of any special endocrine influence, as in the dysgerminoma and the Brenner tumor.

Other tumors arise from undifferentiated somatic cells, and from the erratic cell development as the tumor grows there appear samples of various tissues, as in the dermoids and the teratomas. To the teratomas containing a considerable amount of thyroid tissue are applied the terms "strumous" or "ovarian struma."

A third class of tumors arise from remnants of developed embryonic structures, which formerly functioned but which largely disappear in the maturing of body growth. This class includes the parovarian cysts.

FROM UNDIFFERENTIATED SEX CELLS
WITH ENDOCRINE INFLUENCE

In the past few years interest has been aroused in the study of a group of tumors arising from early oophorogenic structures in the sex gland area. There are two general groups: (1) those which function and produce hormones and in this way determine certain secondary sexual changes, for example, granulosa-cell tumors and arrhenoblastomas, and (2) those which exert no endocrine effect, such as Brenner tumors and dysgerminomas. We are indebted to Robert Meyer of Berlin for his clear-cut classification of these confusing pathologic pictures. The endocrine group will be considered here, and the second group under the next heading.

Granulosa-Cell Tumors

These tumors, according to Meyer, arise from dormant undifferentiated embryonic tissue situated in the medullary portion of the ovary. Such tissue can be found in the fetus and in infants and even into adult life, and occasionally in the ovaries of women far past the menopause. These cells persist without differentiation into late life. Under conditions still unknown they may at any age produce granulosa-cell tumors. These in turn produce estrin and can cause development of secondary sex characteristics in young children or enlargement of the uterus and uterine bleeding in elderly women. They have never been known to develop from mature follicles nor do they ever contain ova. Furthermore, they are found in women from sixty to seventy years of age, in whom the ovary no longer contains follicles.

Of course, much is still unknown about the granulosa cells of the graafian follicle and what they can do in the various stages of growth and retrocession. The studies by Gardiner on the normal and pathological cell activities in the follicles indicate that a variety of tumors may arise from the lining cells.

Structural Pathology.—Meyer gives the following three histologic classifications according to the structure.

1. It may occur as a folliculoma, often associated with small cysts. The cells are arranged about a central liquefied area so that they resemble somewhat small primordial

follicles (Figs. 955 and 956). The similarity to Call-Exner bodies found in rabbit ovaries is very striking. In the first few cases these were thought to be abnormal follicles, because the central cavity superficially resembled an ovum. Meyer stressed the fact that the cells around the small cystic cavities are arranged in a curious antipodal fashion, that is, the nuclei of the inner layer are placed close to the lumen while those of the outer layer are away from it, toward the periphery. Between these two layers there may be several layers of well-preserved cells, or only a thin zone of degenerated cytoplasm may remain. This so-called follicular type may contain small or large cavities.

2. The second and most common type is the cylindroid type, in which there are solid cords of cells or cylinders. Hyaline degeneration of the connective tissue stroma is commonly present. Many bizarre patterns are found, which have been compared by Novak to elaborate scroll work or rippled water or the pattern of moiré silk.

3. Some cases show a diffuse structure which cannot be distinguished from sarcoma. Figs. 957 and 958 show this type of tumor. Speaking of granulosa-cell tumors in general, Novak states that in some cases there seems to be a lutein-like transformation of some of the cells. Where this is found, the endometrial pattern in such cases indicates that there is a secretion of the corpus luteum hormone as well as of the follicular hormone.

Fig. 955.
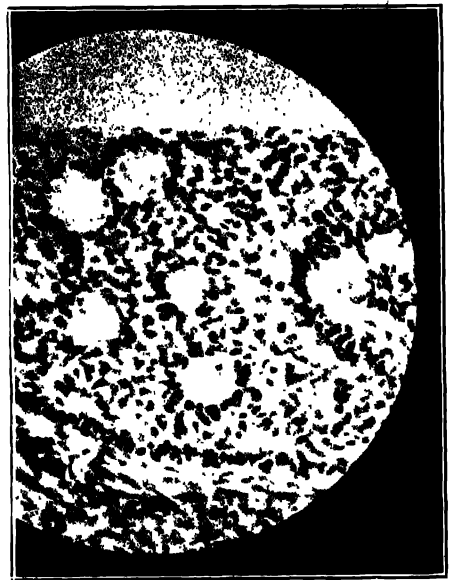
Fig. 956.

Figs. 955 and 956.—Small granulosa cell tumors in the otherwise normal ovary of a woman, aged forty. Fig. 956. Higher magnification of a special area in Fig. 955, showing the resemblance to Call-Exner bodies. (Meyer—*Am. J. Obst. & Gynec.*)

The three types are not infrequently found in different parts of the same tumor, merging into one another and giving the impression of having a common origin. In the recent work of Fischel strong evidence is produced in favor of this idea. Contrary to the generally accepted idea, that the follicular apparatus is the result of a downgrowth of the germinal epithelium covering the ovary into the mesenchyme beneath, Fischel believes that the granulosa cells are formed in situ from the ovarian mesenchyme, as are also the theca cells and stromal cells of the ovary. This theory of follicle development clarifies somewhat the confusing pictures seen in granulosa-cell tumors and seems to fit in much better than do the older theories.

In regard to the degree of malignancy this tumor is felt to be relatively benign, and Meyer emphasizes that it is only necessary in most cases to remove the involved ovary; the fact must not be overlooked, however, that from 5 to 10 per cent of the reported cases have run a malignant course, with recurrence and metastases and death.

These tumors are usually of a moderate size but may vary from very small tumors to huge growths filling the abdomen. On cut surface the small ones present a solid granular surface. In the larger ones cystic areas are seen.

Physiologic Pathology.—The usual picture of the endometrium in these cases is endometrial hyperplasia though this is not always present. In cases showing luteinization of the granulosa cells a premenstrual endometrium may be found. In children there is usually a premature development of the secondary sex characteristics and menstruation. In adult life there may be prolonged bleeding interspersed with periods of amenorrhea due to the inhibition of the pituitary by an excess of estrin in the blood. When such a tumor develops after the menopause, the atrophic uterus may return to normal size and begin to exhibit intermittent bleeding.
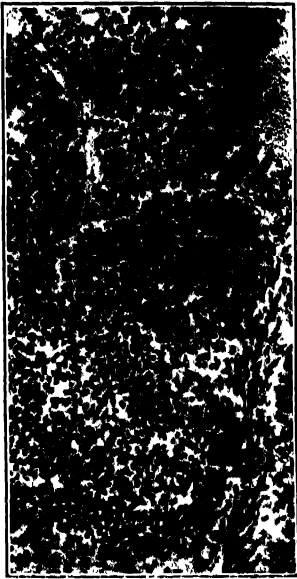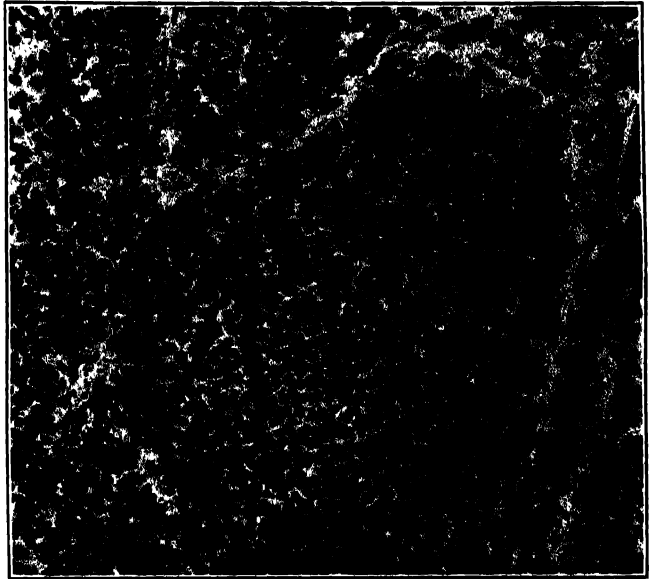
Fig. 957. Fig. 958.

Figs. 957 and 958.—Granulosa cell tumor, Class III. Fig. 957, Shows a diffuse structure resembling sarcoma. Fig. 958, High power of Fig. 957, showing the character of the cells. Gyn. Lab.

Patients with these tumors have more estrin in the urine than do normal patients. The Aschheim-Zondek Type I reaction for prolan A is present in many of these cases and occasionally the Type II reaction is obtained when luteinization is present in the tumor. Extracts made from these tumors and injected into castrate mice cause estrus.

What stimulation causes these undifferentiated sex cells to grow and function is not known. It is probable that the stimulus is endocrine in character. The endocrine influence of the tumors themselves is evident from their cellular structure and from the resulting clinical manifestations. The islands of embryonic sex cells may at any age begin to grow and function, causing symptoms of excessive ovarian activity. The resulting clinical picture varies according to the age of the patient when the tumor cells begin to function.

In children, the excess estrin secreted by these tumors causes precocious puberty, the child maturing sexually at any early age. Menstruation may

appear at two or three years of age, with secondary sex characteristics, such as enlargement of the breasts and appearance of pubic hair. The mental age and activities of the child are not in advance of her years.

Certain cases of precocity reported in the older literature with pictures of patients can now be classified as cases of granulosa-cell tumor, and from these we can learn the life history of such individuals. Lenz in 1913 reported a series of 130 cases of precocious menstruation. In this series were a number of cases in which the flow occurred at birth or within a few days thereafter, which of course we know now may be due to the withdrawal of the maternal estrin at birth. He shows other cases, however, with the photographs proving early maturity, which leave little doubt as to the presence of a granulosa-cell tumor.

Fig. 959. Fig. 960. Fig. 961.

Fig. 959.—Patient, aged about four years, with a granulosa-cell tumor. Lateral view of patient at age of three years and eleven months. Menstruation had begun at three years and seven months. Note the hypertrophy of the breasts. (Novak—*Am. J. Obst. and Gynec.*)

Fig. 960.—Patient aged six years, with a granulosa cell tumor. General view, showing marked general development, the mammary overgrowth, and the broad hips. There is a heavy growth of axillary hair, though it is not seen in the picture. (Novak—*Am. J. Obst. and Gynec.*)

Fig. 961.—The microscopic structure of tumor shown in Fig. 960. (Novak—*Am. J. Obst. & Gynec.*)

That there is precocious development to real sexual maturity in these patients is shown by the fact of early pregnancy. Mandeslo reports the case of a girl who began to menstruate at three and gave birth to a son at six years of age. Lenz refers to the case, reported by von Haller in 1751, in which the patient began to menstruate at the age of two, gave birth to a child at nine, menstruated regularly until fifty-two years old, and lived to the age of seventy-five.

In the cases in which the tumor does not begin until adult life, when the person is already menstruating, the symptoms are frequently masked. There may be an increase in the amount of the menstrual flow, and nothing else to

indicate the tumor. Occasionally there are periods of amenorrhea interspersed with periods of menorrhagia. There have been so few of these cases diagnosed before operation that the number in which hormone tests have been run pre-operatively is not sufficient to permit detailed deductions.

After the menopause, the tumor is likely to cause return of menstruation, or prolongation of menstruation if it becomes active before menstruation ceases entirely.

Fig. 962.

Fig. 963.
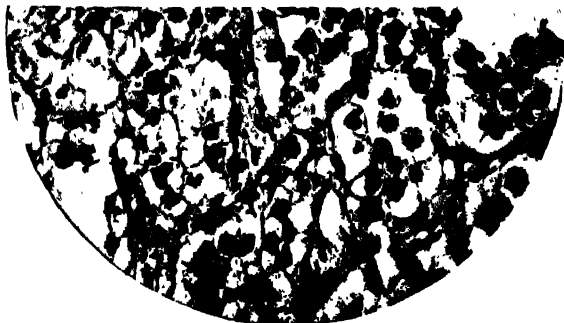
Fig. 964.

Fig. 962 to 964.—Patient, aged seven years, with a granulosa-cell tumor. Fig. 962, General view, showing the precocious sexual development, with marked growth of pubic hair and hypertrophy of breasts. In this case there is also marked enlargement of the abdomen from the tumor. Menstruation began four months before the patient was brought for treatment. Fig. 963, The large tumor removed in this case. It involved the left ovary. After the operation, the precocious menstruation ceased and the patient was well for eighteen months, when she came again with a similar growth of the right ovary, which seemed normal at the first operation. The Aschheim-Zondek test was positive before each operation, and was negative within two weeks after each operation. Fig. 964, The microscopic structure of the first tumor. The structure of the second tumor was the same. (Bland and Goldstein—*Surg., Gynec. and Obst.*)

The association of adenocarcinoma of the corpus uteri with granulosa-cell tumor has been more frequent than to be expected from mere coincidence, and this is an additional indication that excess estrin is a factor in the development of endometrial carcinoma.

Diagnosis.—In children, the diagnosis is made largely on the history and evidences of precocious sexual development. A child, aged four years, with such a tumor, from which menstruation began at three and a half years, is

shown in Fig. 959. Development of the breasts and pubic hair are marked in the child of six, pictured in Fig. 960. The microscopic type of this growth is indicated in Fig. 961.

Novak in a series of 33 cases of granulosa-cell tumors found the following age incidence: First decade 15 per cent, second decade 3 per cent, third decade 12 per cent, fourth decade 21 per cent, fifth decade (ages forty to fifty) 36 per
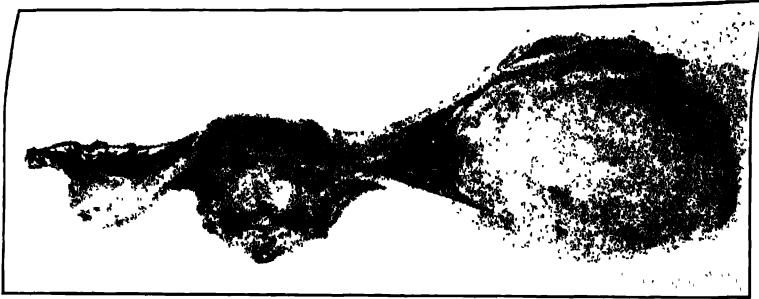
Fig. 965.—Granulosa-cell tumor from a patient, aged sixty-two years. Note well-encapsulated tumor large as a grapefruit, springing from the right ovary. The uterus was enlarged to the size of that of a woman during active menstrual life. (TeLinde—*Am. J. Obst. and Gynec.*)

A.   B.

Fig. 966.—*A*, The microscopic structure of the tumor shown in Fig. 965. Note the follicle-like structure and the islands of solid tumor cells between which is an abundant fibrous stroma. *B*, Microscopic picture of another granulosa-cell tumor from a forty-three-year-old patient. It is composed of two portions, the one follicular, here shown, and a solid portion, part of which is shown in the lower edge of the photomicrograph. Note the lightly staining cells about the periphery of the follicle, resembling theca interna cells. (TeLinde—*Am. J. Obst. and Gynec.*)

cent, sixth decade 9 per cent, and seventh decade (ages sixty to seventy) 3 per cent. The tumors, while not common, are not nearly as rare as was formerly thought.

A girl, seven years of age, with abdominal prominence due to the large tumor and marked development of the breasts and pubic hair, is shown in

Fig. 962. The large tumor removed in this case is shown in Fig. 963, and the microscopic characteristics in Fig. 964. This patient had a similar tumor in the other ovary a year and a half later, and it was successfully removed. Along with the precocious sexual development there is precocious skeletal growth in these cases, so that the child is larger than normal.

Vaginal or rectal examination may or may not reveal an ovarian tumor. These growths are sometimes almost microscopic in size. In women during menstrual life, the diagnosis cannot be made with any degree of certainty, as there are so many other lesions that may give the same symptoms. It is to be considered especially in those patients with clinical symptoms of excess estrin associated with an ovarian mass. The hormone tests should be valuable in a suspected case, and should be run where facilities are available. An unusual elevation in the amount of estrin in the blood or urine in a series of tests, would add weight to the probability of a granulosa-cell tumor. Curettage in the premenstrual stage should show an endometrial hyperplasia in a high percentage of these cases, for it is known that excess of estrin tends to produce such hyperplasia. The diagnostic curettage should be made just before menstruation, because it is at that phase of the cycle that the curettings are most likely to be decisive as to the presence or absence of hyperplasia.

After the menopause, return of supposed menstruation is most likely to be due to endometrial carcinoma. If this be eliminated and there is an enlarged ovary, the lesion is probably a granulosa-cell tumor, though of course it might be a carcinoma of the ovary. A granulosa-cell tumor in the case of a patient, aged sixty-two years, is shown in Figs. 965 and 966.

Treatment.—The treatment consists in operative removal of the tumor.

In the case of a patient in the menopause or later, the question of malignancy must be settled. Though curettage for the abnormal bleeding may exclude malignancy in the uterus, it does not exclude ovarian malignancy. Consequently, if a definite ovarian mass can be felt, operative removal is advisable. In inoperable cases of advanced pelvic tumor, irradiation treatment for ovarian malignancy may be used.

Arrhenoblastoma

The second type of tumor producing endocrine effects is the arrhenoblastoma. According to Meyer, these tumors arise from undifferentiated germ cells which are not utilized during embryonic development but nevertheless retain their sexual potency. Under certain conditions they begin later in life to proliferate and then exert an influence toward maleness. Some types of this neoplasm exert no hormonal effects. The following quotations are from Meyer.

In every embryonic sex gland undergoing development into an ovary, cells at the hilum remain for some time in an undeveloped state (blastema). This blastema under normal conditions later on produces the rete ovarii and some medullary cords or tubules which are homologues of the rete testis and tubuli efferentes of the testicle in the male. The future sexual character of the young embryo is not unalterably determined from the beginning, at least not in all instances, but does depend upon determining factors in the genes in the chromosomes. A priori every embryo and also every embryonic sex gland has the potential faculty of developing in either direction—male or female.

*The rete ovarii and the medullary tubules, which do not exert any functional influ-
ence on the female sex gland, prove the normal bisexual anlage of the gonad. If these
structures then persist in part in an undifferentiated state, and later for unknown reasons
begin to proliferate, they may induce the male direction of development and thus change
the sexual characteristics by creating bisexual stimulation like an ovariotestis.*

*In the hilum of the adult ovary, I found a small tubular adenoma in a very young
stage attached to the rete, which proves this type of neoplasm may have its origin just in
this location. Therefore, it is not the hormonal effect alone which justifies the name ar-
rhenoblastoma but the fact that the resulting masculinization confirms the theory of the
origin of this new growth.*

Structural Pathology.—The tumors are usually unilateral and seldom get
very large. On cut surface they have a soft consistency and are pale yellow
in color. There are two distinct morphologic forms and a third which holds
an intermediary position.

A.   B.
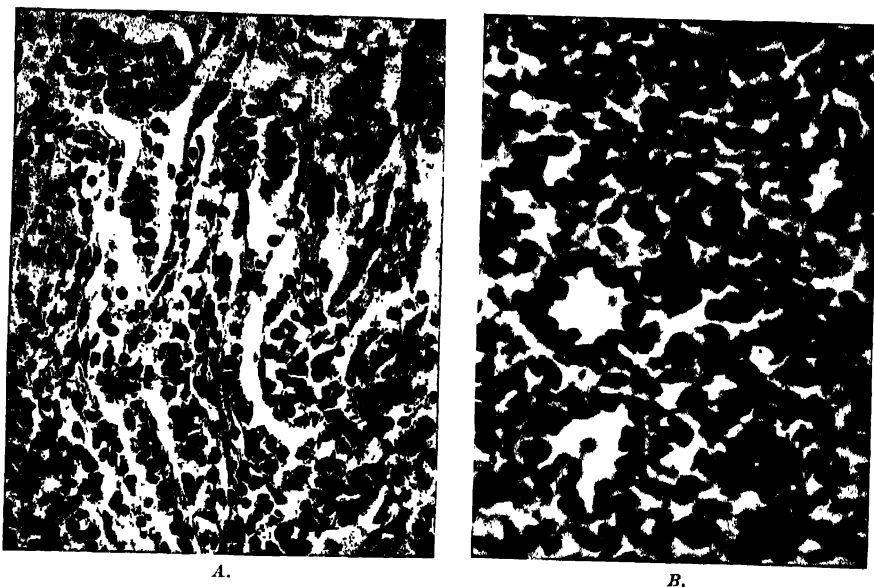
Fig. 967.—Arrhenoblastoma, atypical group. A, Showing the irregular epithelial cord-
like structures. B, Showing the sarcoma-like structure of these tumors. Some tendency to
tubule formation is seen. (Taylor, Wolfermann, and Krock—*Surg., Gynec. and Obst.*)

1. The type described by Pick and named by him "adenoma testiculare
ovarii" consists of an adenomatous structure made up of tubules resembling
seminiferous tubules of the testis. It is not only similar to the adenoma devel-
oping in men but also contains some of the same structures. Masculinization
occurs only occasionally in these cases.

2. The intermediary group shows sarcoma-like tendency but usually rudi-
mentary cords or irregular tubules could be found (Fig. 967-A). Women with
this type showed a little more tendency toward masculinization, amenorrhea,
hirsutism, etc.

3. Atypical variety, resembling sarcoma with little to suggest its origin.
Most of these patients showed marked masculinization. Fig. 967-B shows such
a growth.

Physiologic Pathology.—In every woman there are rudimentary homologues of male structures. The one of importance in arrhenoblastomas is the rete ovarii which is the homologue of the male testis. Under certain unknown conditions this undifferentiated male tissue, near the medulla of the ovary, becomes active and produces a male endocrine influence which overrides the female influence, resulting in varying degrees of intersexuality.

In the first type there is very little tendency toward masculinization, in the second type there is a greater tendency that way, with amenorrhea and hirsutism or more marked changes if the cells are more nearly like Type III. In Type III, where the potential testicular tissue is extremely undifferentiated, the most marked masculinization occurs.

Diagnosis.—These tumors occur much less frequently than do the granulosa-cell tumors. There is no reported series large enough to estimate with any accuracy the age incidence.

Fig. 968.   Fig. 969.   Fig. 970.

Figs. 968-970.—Patient with an arrhenoblastoma of the ovary, showing the masculinity the tumor caused and its subsidence after removal of the growth. Fig. 968, Showing the development of hair on the face. Fig. 969, Showing the developing masculine type of pubic hair growing upward toward the navel, and the flatness of the breasts as compared with Fig. 970. Fig. 970, Six months after removal of the tumor. Note the return of the feminine type of breasts and hip-outline, and the lessening of the hypertrichosis on the face. (Taylor, Wolfermann and Krock—*Surg., Gynec. and Obst.*)

The patient usually becomes amenorrheic, hair appears on the face, and the pubic hair assumes a masculine appearance (extending upward in median line toward navel), the breasts become flattened, the voice deepens, and the clitoris enlarges. In long-standing cases the figure assumes a masculine character. The clinical features are shown in Figs. 968 to 972.

The diagnosis is made from the appearance of the patient, the history, and the finding of an ovarian tumor. In the differential diagnosis one must rule out basophilic adenoma of the anterior pituitary, adrenal cortex lesions, especially cortical hyperplasia, and pineal tumors.

In basophilic adenomas, the patients are usually very fat, and they have other symptoms referable to a pituitary lesion. Hirsutism is usually not a marked feature.

In adrenal disorders there is a marked hirsutism, and the breasts usually remain of normal size. A tumor may occasionally be felt in the kidney region, and there may be other adrenal symptoms.

Adrenal tissue may occur in the ovary and produce a tumor there. Such an ovarian tumor has much the same masculinizing influence as an arrhenoblastoma, so the differentiation has to be made by microscopic examination after removal of the growth.

In pineal tumors there is frequently calcification of the gland which can be seen in the x-ray. There is usually some evidence of increased intracranial pressure with an internal and external ophthalmoplegia and an impairment of the upward gaze. Secondary sex characteristics need not be changed.

Fig. 971.   Fig. 972.

Fig. 971.—Facial hirsutism from an ovarian arrhenoblastoma in a patient age sixty-one years.

Fig. 972.—Three months after removal of the arrhenoblastoma, showing disappearance of the abnormal hirsutism. (Maxwell—*Western J. Surg.*)

The treatment for an arrhenoblastoma is removal. This causes a complete reversal to the feminine type. The abnormal hair drops out, the menses reappear, and the breasts assume the normal fullness. Figs. 968 to 970, show such a patient in the childbearing age, before and after operation, and Figs. 971 and 972 show one in the post-climacteric age.

Adrenal Ovarian Tumor

Novak, in his article on masculinizing tumors of the ovary, calls attention to the occasional occurrence of adrenal adenoma in the ovary and in the broad ligament. The endocrine effect, when present, is toward masculinization and hence the adrenal tumor may be mistaken for an arrhenoblastoma till removed and sectioned.

The microscopic picture, particularly the large lutein-like cells, has caused confusion with corpus luteum growths. Novak agrees with Schiller that most of the so-called luteomas of the ovary are really tumors of adrenal tissue. Rests of adrenal tissue occur in the ovary, and this fact must be taken into consideration in interpreting the microscopic pictures in uncertain conditions.

FROM UNDIFFERENTIATED SEX CELLS
WITHOUT ENDOCRINE INFLUENCE

Certain tumors in this situation develop from undifferentiated sex cells which show no tendency toward specific male or female characteristics. They include the dysgerminoma and the Brenner tumors.

Dysgerminoma Ovarii (Seminoma)

The dysgerminoma arises according to Meyer from undifferentiated germinal cells which have lost their power of becoming either masculine or feminine, and therefore can develop into identical pathologic structures in either the

A.   B.
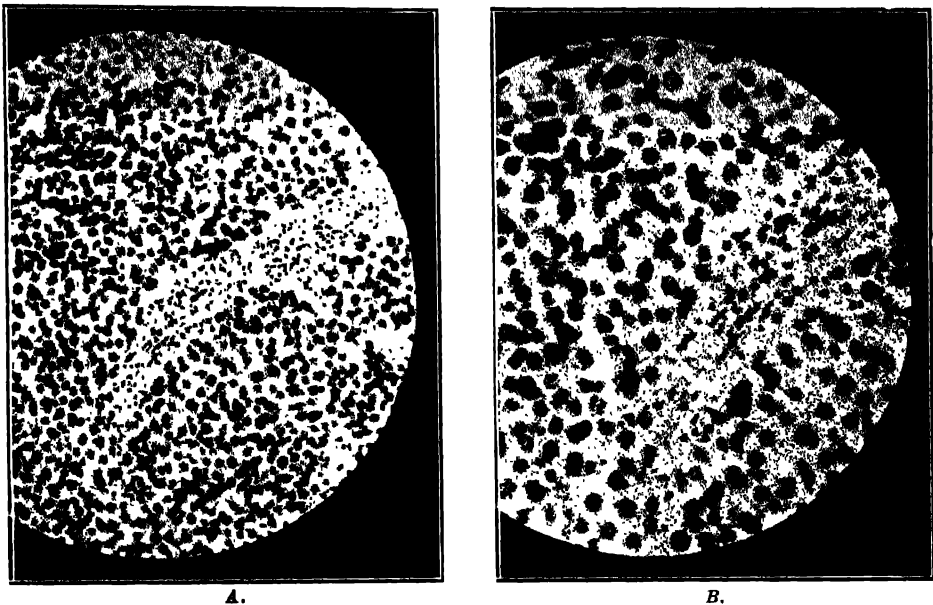
Fig. 973.—Dysgerminoma of the ovary. A, Shows the resemblance to dysgerminoma of the testicle. B, High power of A. (Meyer—Am. J. Obst. and Gynec.)

testis or the ovary. They are very common in pseudohermaphrodites, in ovario-testis, and in poorly developed sex glands of otherwise normal persons. They are devoid of any specific sex influence and exert no hormonal action either toward masculinization or feminization.

The growths are rather rare generally but are common in pseudohermaphrodites. They usually appear in the second or third decade of life.

Meyer states that these tumors may attain enormous size, destroying the ovary and adjacent uterus. They are frequently bilateral. They are solid, grayish white, and doughy in consistency.

These tumors in the ovary have the same microscopic characteristics as they do in the testis, with the exception that there are no tubules present in the ovary. There is an alveolar arrangement of the large epithelial cells of the new growth. In some cases there is a cordlike arrangement of these large cells. There is a marked infiltration of the connective tissue. Fig. 973 shows a dysgerminoma of the ovary. These tumors are relatively benign.

Brenner Tumors

The Brenner tumors probably arise from the derivatives of the coelomic epithelium, as do the Walthard cell foci in the infantile ovarian cortex. If the Walthard cell foci retain their indifferent character in the course of their blastomatous development, the Brenner tumor results.
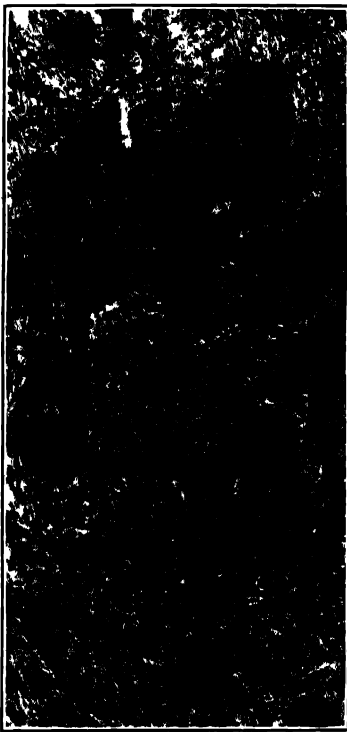
Fig. 974.   Fig. 975.

Fig. 974.—Brenner tumor, Type I. There are a few hollow spaces seen but no large cysts.

Fig. 975.—High power of the upper portion of the Y-shaped nest of cells seen in Fig. 974, showing the character of the cells. Gyn. Lab.

These tumors are usually unilateral and of moderate size. On cut surface, they are white in color and sharply defined and suggestive of a fibroma. The cystic type cysts usually contain pseudomucin.

Two types are described by Meyer: (1) solid tumors with or without small cysts, and (2) cystomas with or without pseudomucinous epithelium and containing nodules or Brenner cell tumors in the wall. A marked hyalinization of the stroma is characteristic, and there is a definite capsule present.

In the first type there are nests of epithelial cells embedded in the fibrous connective tissue. In the center of the nests there may be hollow spaces and cysts with indifferent cylindrical or mucous epithelium. Centrally, the cells are parallel to the long axis of the nodule while peripherally they are at right angles.

If the differentiation of the cell foci tend primarily in the direction of cyst formation, the second type of Brenner tumor is the result. In this type actual cystomas appear, and may or may not be lined by pseudomucinous epithelium. Maury and Schmeisser have reported a case of bilateral Brenner tumor in which the tumor in one ovary was of the first type and the one in the other ovary of the second type.

Fig. 976.   Fig. 977.

Figs. 976 and 977.—Brenner tumor. Fig. 976, Presents a characteristic picture at low power. Irregular stroma, epithelial masses varying in shape. They are partly hollow. They contain mucin. Narrow hyaline bands surround the epithelium. They are small cysts. Fig. 977, Partly hollowed out, pseudomucin containing epithelial mass. The outermost cells are conspicuous by their small, dark nuclei. (Plaut—*Surg., Gynec. and Obst.*)

Various microscopic characteristics are shown in Figs. 974 to 977. Proescher and Rosasco in reporting a case and discussing the subject state:

The epithelial part of the tumor does not develop from the ovarian parenchyma nor from the granulosa-cell islands, but from special cell elements which are not derived from the normal cells forming the ovary, but are abnormal cell inclusions which are found in Walthard's cell islands. According to R. Meyer, they originate from the celomic epithelium near the wolffian body, from which the epithelium of the müllerian duct is derived. The latter may form solid epithelial nodules, or larger formations of indifferent epithelium in abnormal locations, as in the tubes and ligaments. It may differentiate into mucous or columnar epithelium, like the surface epithelium of the ovary.

Walthard's cell islands are capable of forming tumors which not only contain mixtures of Brenner epithelium and pseudomucinous and serous cysts, but pure areas of these types of cells may occur side by side. Also pseudomucinous cysts may form without Brenner epithelium. The Brenner tumors are linked genetically with the majority of the serous, partially fibrous, and adenomatous and papillomatous cystomata, including the adenofibromas and the mixed seromucinous tumors. Only a small percentage of the pseudo-

mucinous cysts and cystomata originate from Walthard's cell islands. The majority constitute the endodermal part of a teratomatous anlage, which dates back to the early segmentation of the ovum.

The Brenner tumors have no clinical peculiarities save their frequency of occurrence at an advanced age, 50 per cent occurring after fifty years of age. They are benign and no metastases or recurrences have been observed. Malignant tumors arising from Brenner's epithelium are, so far, not known.

Novak, in reporting a series of cases, gives the following summary:

This paper is based upon the study of 17 cases of Brenner tumor of the ovary, including the 14 new cases herein reported. This brings the total of reported cases to 122, though new instances are being reported more and more frequently. The tumors are benign, and produce no characteristic symptoms. When small they are, therefore, likely to be found only accidentally in operations for other indications. They may, however, reach very large size, in which case they produce discomfort or pain, with perhaps the presence of a mass noticeable to the patient herself. The pathologic characteristics have been described in the paper. The essential elements are (1) the presence of nests or columns, often partially cystic, of rather uniform size and appearance embedded in (2) a matrix of fibromatous tissue which is sharply marked off from the surrounding ovarian stroma though there is no definite capsule. The tumors probably arise from the so-called Walthard islands of indifferent cells which may at times occur in the ovary, though other explanations have been suggested.

The most interesting histologic characteristic is the frequently observed transition of the cells into a cylindrical type identical with that characterizing the ordinary pseudomucinous cystadenoma, so that large tumors of the latter variety may be produced, with only small nodular Brenner tumor vestiges in the wall to indicate their origin. There is logic, therefore, in the subdivision of Brenner tumors into the solid and cystic varieties. Three such tumors are included in our series. On the other hand the fibromatous reaction may be so striking as to produce large fibromas of the ovary. In such cases, of which 2 are included in our group of cases, the origin is indicated by the finding of the typical cell nests scattered either sparsely or richly throughout the tumor. There is little or no evidence to indicate that Brenner tumors exert any such endocrine effects upon sex characters as those which characterize granulosa cell carcinoma or arrhenoblastoma.

Because of the absence of any hormonal manifestations from these tumors, the diagnosis of the type of growth is made after removal.

UNDIFFERENTIATED SOMATIC CELLS

Tumor growth of embryonic rests of undifferentiated somatic cells gives rise to the dermoids and teratomas. The cystic dermoid tumor represents an adult type of growth and the solid teratoma an embryonal type.

Dermoid Cysts

Dermoid cysts, according to Ewing, constitute 10 per cent of all ovarian tumors. They are present at birth but are not discovered usually until later in life, between thirty and forty, when their growth begins to cause symptoms. Early in life they grow rapidly, but remain stationary after reaching a certain limit of development.

Rupture of dermoid cysts is a common occurrence, and the discharge of the irritating sebaceous material causes a marked peritoneal reaction and dense adhesions.

The origin of these growths is still an undecided question. Wilms feels that they are due to a parthenogenetic development of the unfertilized ovum. Goodall is in accord with this view.

Dermoid cysts are usually globular in shape and dull white in color. They contain structures associated with epidermal tissues, such as hair, teeth, bone, sebaceous material resembling fat. Specimens are shown in Figs. 978 to 980.

Occasionally on close inspection hair can be seen through the wall. They have a doughy consistency, with very hard areas where bony structures are present. When opened, a fatty, semisolid sebaceous material flows out. Hair and skin are nearly always present. The tumors contain elements of all three layers of the blastoderm as has been shown by Bonnet. The solid tissue is usually on one side of the tumor and is called the "dermoid plug."

Fig. 978.—Dermoid cyst of the ovary. Gross specimen, showing several teeth in the lower right portion of the specimen and hair in the cystic portion on the left. Gyn. Lab.

The following is a partial list of tissues which have been found in dermoids: Skin and its derivatives, sebaceous glands, hair, sweat glands, and bone, especially the maxillae containing teeth. Up to 300 teeth have been found in one cyst. Rokitansky observed the eruption of permanent teeth after the discharge of the milk teeth. Milk teeth are more common in teratoma while the permanent teeth are usually found in dermoids. Long bones, digits, fingernails, and skull have been found. Brain tissue with its derivatives, intestinal loops, thyroid tissue, eyes, salivary glands, may occasionally be found. Even rudimentary fetuses have been described, such as a pelvis with hairy pubes and a vulva and clitoris. Brains with ventricles, spinal cord, and a few complete extremities, have been observed. Figs. 978 and 980 show opened dermoids in the gross, and Fig. 979 a microscopic picture of the wall structures.

Ewing states that dermoids become malignant in about 3 per cent of the cases and the type of malignancy is usually squamous-cell carcinoma of the contained epidermis. Fig. 1023 shows such a case.

Fig. 979.—Dermoid cyst. Microscopic picture showing a hair follicle, sebaceous glands, sweat glands, and squamous epithelium. Gyn. Lab.
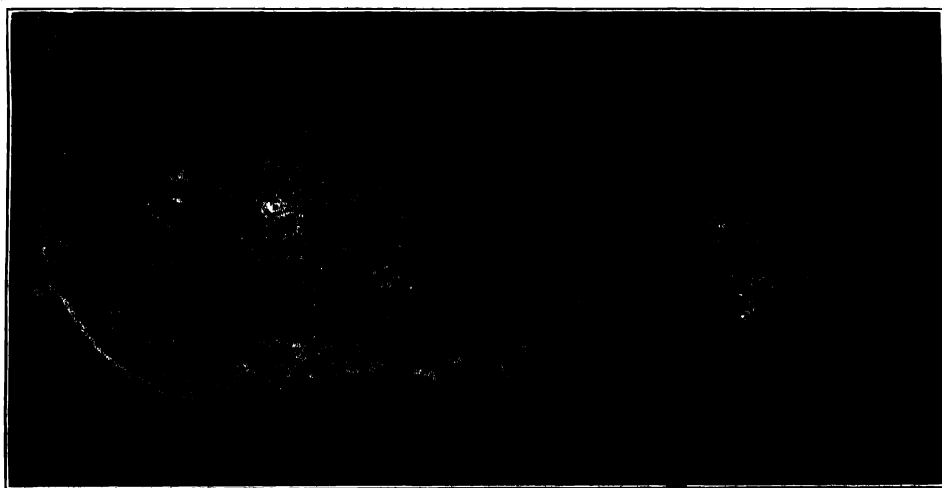
Fig. 980.—A small dermoid cyst, showing teeth, hair, sebaceous material and firm fat tissue. The teeth, shown in the right side, are unusually well developed and constitute a point of special interest in this specimen. (Courtesy of Dr. F. J. Taussig.)

Symptoms and Diagnosis.—Dermoid tumors may appear at any age. They have been found in children at birth and in women at ninety years. Dermoid tumors of the ovary are comparatively small, rarely getting larger than a child's head. But they are more dangerous than the ordinary large cysts, for the dermoid cysts usually present more and firmer adhesions, and their contents are

more irritating, so much so that the escape of any of the contents into the peritoneal cavity is likely to cause a peritonitis.

The symptoms of dermoids are about the same as for ovarian cysts in general, which are given in detail later in this chapter under Proliferating Cysts. In dermoid cysts there may be present a firmer surface on palpation. As they often contain bone or teeth, x-ray examination may assist in determining the character of the pelvic mass felt in pelvic palpation.

Morris and Rosenthal in studying a series of 79 cases, found teeth or bone alone or in combination, in 39 cases or nearly 50 per cent. They remark "Had x-ray been more frequently employed a high percentage of these tumors could have been diagnosed before operation."

Dermoids are more liable to suppuration and abscess formation than the ordinary cyst. Such abscess may rupture into the lower bowel, with discharge of bony material from the rectum. In such case differential diagnosis must be made between dermoid cyst and extrauterine pregnancy as the original trouble.

Quinby reports a dermoid which ruptured into the bladder. Carter, Thomas and Pearse reported a dermoid cyst which ruptured into the bladder and into the sigmoid, producing a very complicated condition. By means of pelvic, cystoscopic and gastrointestinal x-ray examinations the details were finally worked out.

Treatment.—The treatment of dermoid tumors which have become large enough to be appreciated and give trouble, is removal by operation, the same as for proliferating cysts. The fact that they may develop malignancy is an additional reason for prompt removal.

Teratomas

In certain of the tumors arising from undifferentiated somatic cells there is not so much development toward mature structures as in the dermoid cysts, but the growth is more solid and has more embryonic tissue. It is to such a tumor that the term "teratoma" is applied.

The cells being less developed and their activities more erratic than in the dermoid, there is a greater tendency to malignancy. There are usually small areas of partly mature tissue, such as bone, cartilage, hair, etc. There may be small cavities. Areas of hemorrhage are not uncommon. If the growth contains a considerable amount of thyroid tissue, it is designated "ovarian struma."

Clinically, on account of the tendency to malignancy, the teratoma is a very serious type of growth. Any tumor suspected to be of this character should be subjected to prompt operation, if the patient's condition will permit.

TUMORS FROM DIFFERENTIATED EMBRYOLOGIC REMNANTS

Growths of this class are represented principally by the tumors of the broad ligaments arising from the parovarium, which consists of remnants of structures which served their purpose during embryologic development and then largely disappeared.

Parovarian Cysts

The tumors of the parovarium (broad ligament tumors) are almost invariably cysts, and they are of two kinds: simple cysts and papillary cysts.

The **simple cysts** are single cysts containing clear fluid resembling water. On account of their confined position they produce very troublesome symptoms while still small. They arise from various parts of the remains of the wolffian body (parovarium, paroophoron).

The lining of these cysts consists, as a rule, of a single layer of flattened epithelium resting on a fibrous stroma. They rarely become malignant.

The **proliferating papillary cysts** arise also from the remnants of the wolffian body and their characteristic is the development of papillary growths in the interior of the cyst, which fill the cyst and grow through its wall, and spread to the peritoneal surface and the adjacent organs (uterus, ovaries, intestines). The whole pelvis may be filled with these warty cauliflower growths and, having spread to all the adjacent structures, they often give rise to an erroneous diagnosis of cancer.

In the majority of cases they are bilateral and usually rupture before attaining a large size. Though they grow rapidly and spread to adjacent organs, where they implant themselves on the peritoneal surfaces and grow freely, they do not have the fatal infiltrating and destructive tendency of malignant disease, and many patients recover when the abdomen is opened and the larger part of the growth removed. Later they may undergo malignant change, and then they present the usual characteristics of carcinomas.

These proliferating papillary cysts arise from the parovarium. As most parovarian tubules lie in the broad ligament, the papillary cysts are usually broad ligament cysts. But they may also arise from that part of the parovarium which is prolonged into the hilum of the ovary. It is from that location that the papillary cysts of the ovary arise. The papillary cysts of the ovary are usually bilateral and present all the characteristics of the broad ligament papillary cysts, except that they arise from the ovary instead of from the broad ligament.

Symptoms and Diagnosis.—In the clinical history and in the signs obtained by examination, broad ligament tumors resemble ovarian tumors very closely. Practically the same symptoms and signs which serve to distinguish an ovarian tumor from other diseases serve, also, to distinguish a broad ligament tumor from the same diseases. So that, as a rule, in this condition, when there is trouble in diagnosis, the difficulty is to tell whether the tumor present is a broad ligament tumor or an ovarian tumor.

The characteristics of the ordinary parovarian cysts, or "broad ligament cysts," as they are usually called, are as follows:

1. They grow into the broad ligament, separating its layers and displacing the adjacent organs. The uterus is pushed far to one side, and the tube is usually stretched over the cyst, being much lengthened and flattened (Figs. 981 to 984). The ovary also may be flattened out on the surface of the cyst. There is more or less fixation of the cyst and also of the displaced uterus. They may grow under the peritoneum and separate it from the rectum, bladder, and abdominal wall.
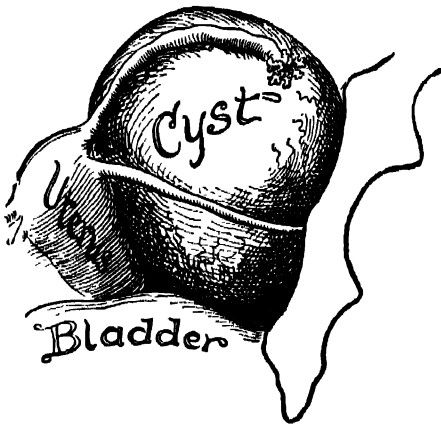
Fig. 981.
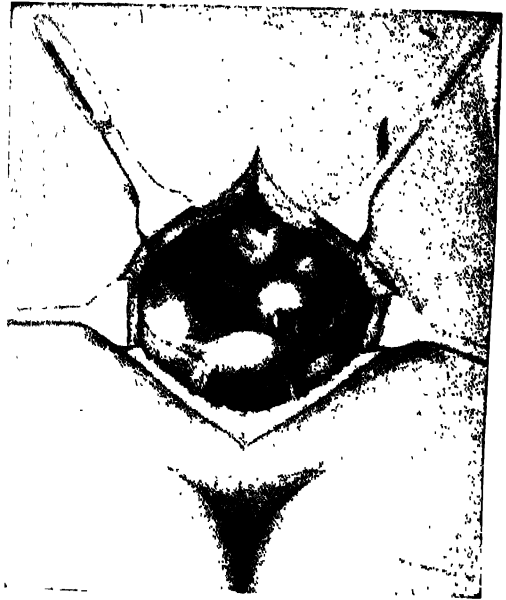
Fig. 982.

Fig. 981.—A parovarian cyst, forming a large mass and displacing the uterus. (Ashton— *Practice of Gynecology*, W. B. Saunders Company.)

Fig. 982.—Graafian-follicle cysts of the ovaries, which have become intraligamentary (Kelly—*Operative Gynecology*, D. Appleton-Century Company.)

Fig. 983.—Parovarian cyst from left side, view from above. The ovary is seen at the upper left portion. Just below it to the left is the severed uterine end of the tube, from which the flattened tube may be traced under the peritoneum to its fimbriated end near the center of the drawing. As the cyst grew in its situation between the layers of the broad ligament the sides of the ligament were spread apart, the ovary was raised, and the tube was stretched out and flattened. Gyn. Lab.

2. They produce serious symptoms much earlier than ovarian cysts. This is due to their being confined within the broad ligament and the pelvis, and hence making serious pressure on surrounding organs while they are still small. For this reason they cause more pelvic pain and more menstrual disturbance than ovarian cysts of the same size.

The papillary cyst, after rupture and spread of its papillary growths, may produce a clinical picture very much resembling tuberculous peritonitis or chronic pelvic inflammation. It then usually gives rise to marked ascites, and the fluid returns repeatedly after tapping.

The **rapidity of growth** of the broad ligament tumors depends somewhat on the character of the growth. Those of slow growth are usually simple cysts. The papillary cysts grow rapidly at the last, though the growth may be slow while confined within the broad ligament.

Treatment.—The treatment for broad ligament tumors is the same as for ovarian tumors—that is, removal by abdominal section. In some cases of simple cyst, very low in the pelvis, with the patient in bad condition, it is better to open the cyst from below, drain away the fluid and pack the cavity, keeping the wound open until the cavity is obliterated, the same as in the treatment of pelvic abscess. Some cases may be permanently cured in this way with much less danger than by abdominal section.

Ordinarily, however, the preferable operation is abdominal section. The operation for a parovarian cyst is somewhat more difficult than for an ovarian cyst owing to the fact that the parovarian growth lies between the layers of the broad ligament. This necessitates opening the broad ligament to extract the cyst and also necessitates careful closure of the remaining broad ligament cavity to prevent oozing or secondary hemorrhage.

Downing and Otoole in their study of parovarian cysts complicating pregnancy, collected sixty-two reported cases, but in only seven did the cyst produce dystocia. They report a case causing dystocia and requiring aspiration of the cyst to permit delivery.

TUMORS DUE TO TRANSPLANTATION OR HETEROPLASIA

This type of tumor is represented by the endometrial cyst of the ovary, so named because it contains tissue resembling the endometrium of the uterus.

Endometrial Cysts of Ovary (Pelvic Endometriosis)

Endometriosis is a serious pelvic disease concerning which little was known up to about two decades ago. The pathology has now been worked out very well, and we know that this process is responsible for the major portion of those dense adhesions found in patients without definite pelvic infection. The clinical significance, however, of this pathologic process—that is, its importance in everyday treatment and operative work—has not been sufficiently recognized.

The first thing that started the investigations which finally made clear the life history of this strange growth was the discovery that some uterine myomas contained glands, in addition to the muscle and connective tissue. This particular type of myoma, which

Fig. 984.—A Parovarian Cyst of the Broad Ligament. Drawing from fresh specimen. Notice how the tube is stretched out over the mass and how the peritoneum extends from the tube out over the cyst in all directions.

contained glands, was designated adenomyoma. Further study developed that the adeno-
myoma differs from the ordinary myoma, not only in containing glands but also in two
other important characteristics. First, it shows a tendency to grow into the surrounding
tissue instead of pushing it aside, that is, it is not well encapsulated like the regular
uterine myoma but tends to infiltrate the surrounding uterine wall and become diffuse.
Second, it is not confined to the uterus, but is found in many different situations in the
pelvis and lower abdomen even as high as the umbilicus.
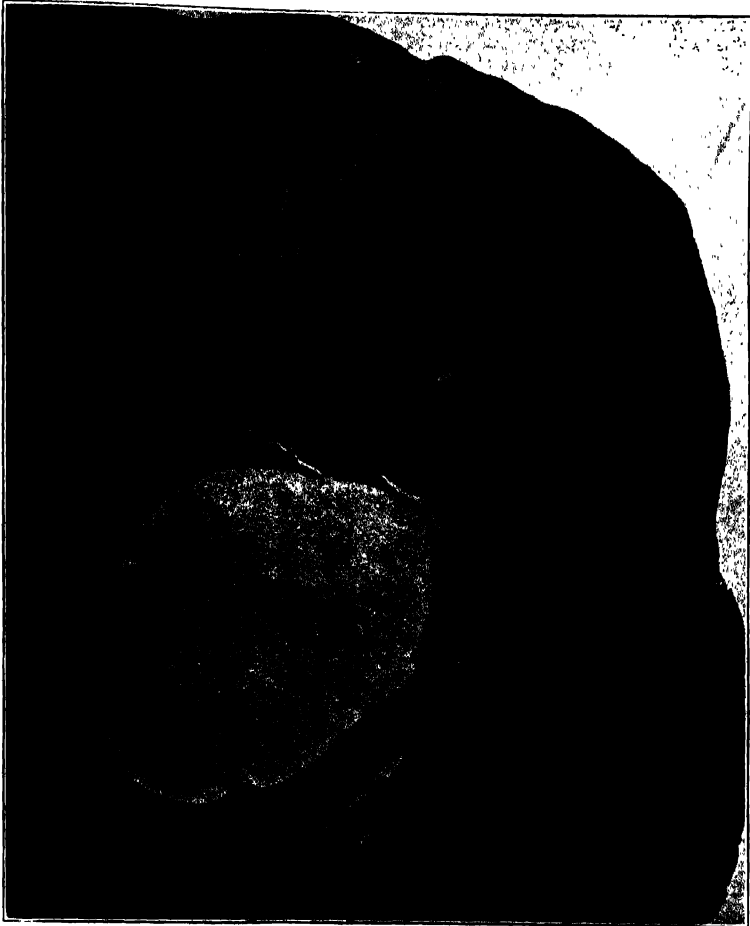
Fig. 985.—Endometrial cysts of ovary. A section from the upper part of an ovary. In
the lower wall of the upper cavity and the upper wall of the lower cavity a layer of endometrial
tissue may be seen. In the upper cyst cavity blood and fibrin still remain. Gyn. Lab. (Schwarz
and R. J. Crossen—*Trans. Am. Assn. Obst., and Gynec.*)

Next arose the question as to how there came to be glands among the muscle bundles.
Where did the glands come from? A careful study of the adenomyomas near the uterine
cavity indicated that those glands came from outward growth of the glands of the adjacent
endometrium. In some cases it was possible to establish a direct continuity of the glands
in the endometrium with those in the tumor. But there were adenomyomas in the outer
part of the uterine wall having no connection whatever with the endometrium. There
were also similar tumors in distant situations, not even connected with the uterus. How
did the glands, resembling uterine glands, get into those tumors distant from the endo-
metrium? It was eventually discovered that there were certain cysts of the ovary con-

taining such glands, and that wherever they came in contact with the uterine wall there were ingrowths of these glands, forming an adenomyoma in the outer portion of the uterus. Again, leakage from these cysts carried gland cells which caused similar glandular ingrowths wherever they lodged.

The tracing of the connection between these cysts of the ovary and adenomyomas forms an interesting chapter in medical history. Cullen, in his illuminating writings on uterine adenomyoma and the distribution of the same in the pelvis and lower abdomen, called attention to the fact that they occasionally occur in the ovary. Finally Sampson, through his laborious and brilliant work, was able to establish the identity of the structure of a certain type of ovarian cyst with the uterine endometrium and with the glands in adenomyomas.
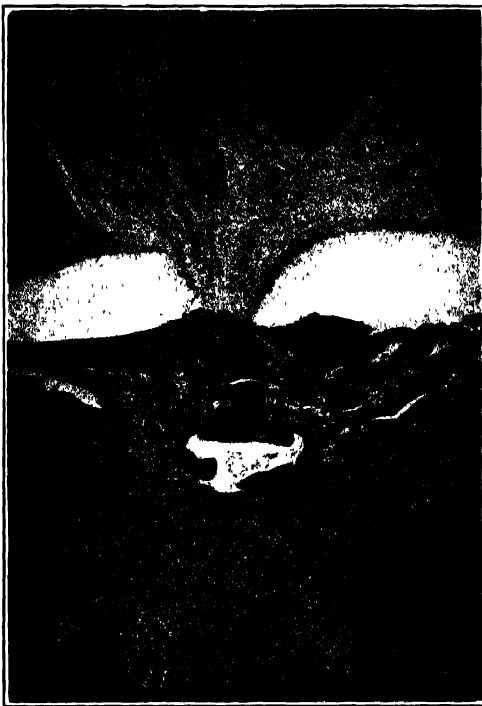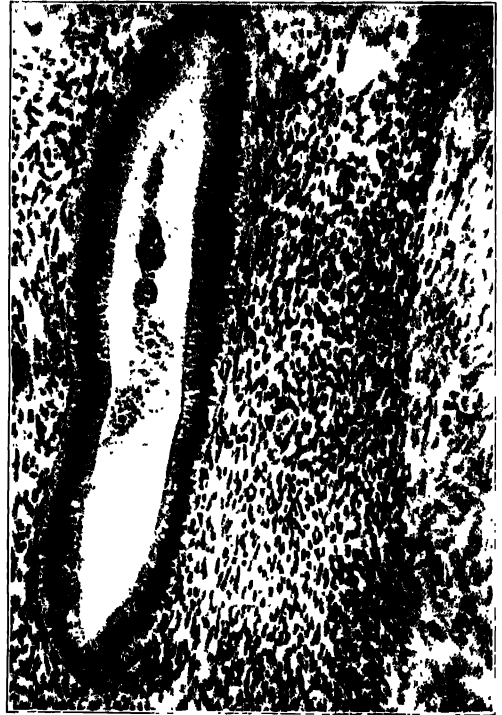
A.   B.

Fig. 986.—Endometrial cyst of ovary. A, High power from the lower wall of the upper cyst in Fig. 985, showing typical uterine glands and stroma. B, Higher power, showing details of a gland and the surrounding stroma. The solid tissue about the two cysts is hyperplastic ovarian stroma. Gyn. Lab. (Schwarz and R. J. Crossen—*Trans. Am. Assn. Obst. and Gynec.*)

It had long been noted that old blood was frequently found in small cysts of the ovary. Aside from the normal blood-filled corpus luteum (which undoubtedly constitutes some of the "blood cysts" removed by inexperienced operators), blood from hemorrhage may be found in various types of cyst—the follicular cyst,—the corpus luteum cyst, and the ordinary proliferating cysts (pseudomucinous and serous). These hemorrhages are all accidental. Sampson was able to show, however, that there is a particular type of cyst in which the extrusion of blood into the cavity is not accidental, but a part of the regular development.

This cyst is lined by a tissue made up of glands and stroma resembling the endometrium of the uterus. Not only does this tissue look like endometrium, but it also acts like endometrium—that is, it menstruates. Along with the uterine endometrium it passes through the regular phases of menstruation. Blood is extravasated into the tissue and passes into the cavity. In the closed cyst there is no outlet for this menstrual blood, so

it accumulates and distends the cyst. The retained blood undergoes more or less disorgani-zation, and constitutes the dark chocolate-colored material which so often escapes from the cyst as the adhesions are broken in operative removal.

Definition.—In regard to terms used, "pelvic endometriosis" is the general term used to designate the appearance of endometrial tissue outside its usual location. If it appears in the ovary, it is likely to form a cyst, which is designated an "endometrial cyst" of the ovary. If the glands penetrate the uterine muscle, the process with the resulting condition is called "adenomyosis." If the adenomyosis causes a distinct tumor formation, that is called an "adenomyoma."
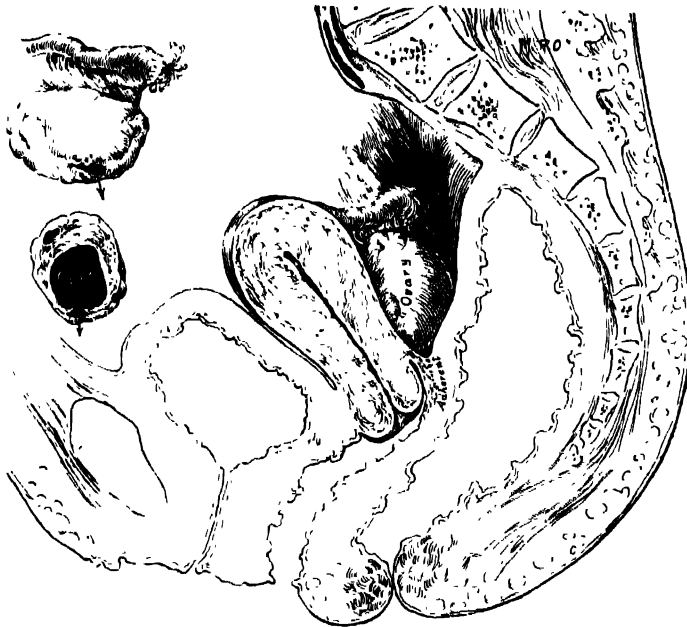
Fig. 987.—Endometrial cyst of ovary. The ovary is prolapsed and adherent. Perforation of the cyst wall has taken place, with gravitation of contents to the cul-de-sac and the forma-tion of adhesions there. The insert shows the ovary sectioned and, also, the perforation through the cyst wall and ovarian surface. (Sampson—*Arch. Surg.*)

Etiology.—There are several theories as to the etiology of this condition.

1. Transtubal implantation (Sampson). This is the first theory offered. Sampson thought that in certain cases during menstruation some of the blood and endometrial tissue passed out through the tubes into the peritoneal cavity. This endometrial tissue became implanted and grew at the point where it happened to fall. Any condition causing obstruc-tion to the free cervical exit of the menstrual blood was presumed to be a factor in this transtubal implantation. This tissue after becoming implanted continues to function as endometrium and, as a result, menstruates. After a number of menstrual periods the trans-plant becomes a blood-filled cyst.

Owing to the increasing pressure within and the endometrial growth penetrating the wall, there is some leakage of cyst contents into the peritoneal cavity. This endometrial leakage causes adhesions of the cyst to surrounding structures with endometrial penetration of the adherent area. Very frequently there is gravitation of material to the posterior peritoneal cul-de-sac with adhesions and penetration and infiltration there. This process of leakage and growth may continue, forming dense adhesions throughout the pelvis.

The arguments for the transplantation theory of the origin of endometrial ovarian cysts are: (a) in endometriosis the tubes are usually patent, (b) the islands of endometrial
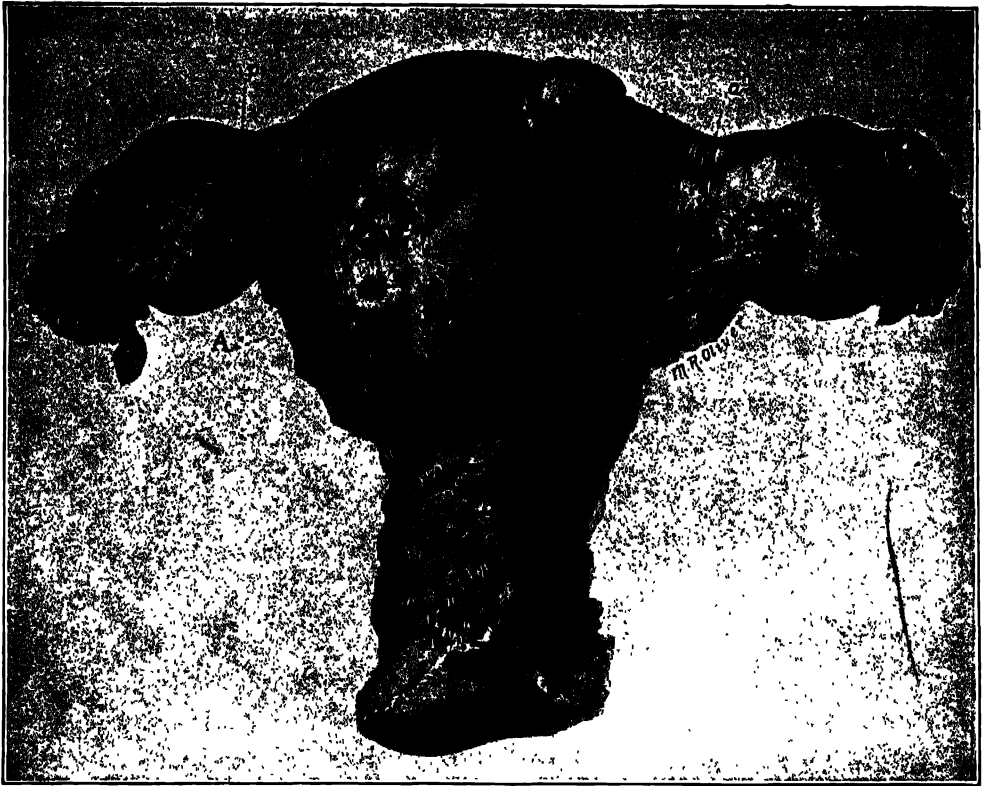
Fig. 988.—Endometrial cysts of ovary with peritoneal involvement (pelvic endometriosis). A cyst in each ovary has perforated, and from the cyst in the right ovary the contents are leaking out. At operation both ovaries were found adherent to the posterior surface of the uterus. Where the left ovary was adherent (A) a superficial adenomyosis is developing in the uterine wall. (Sampson—*Arch. Surg.*)
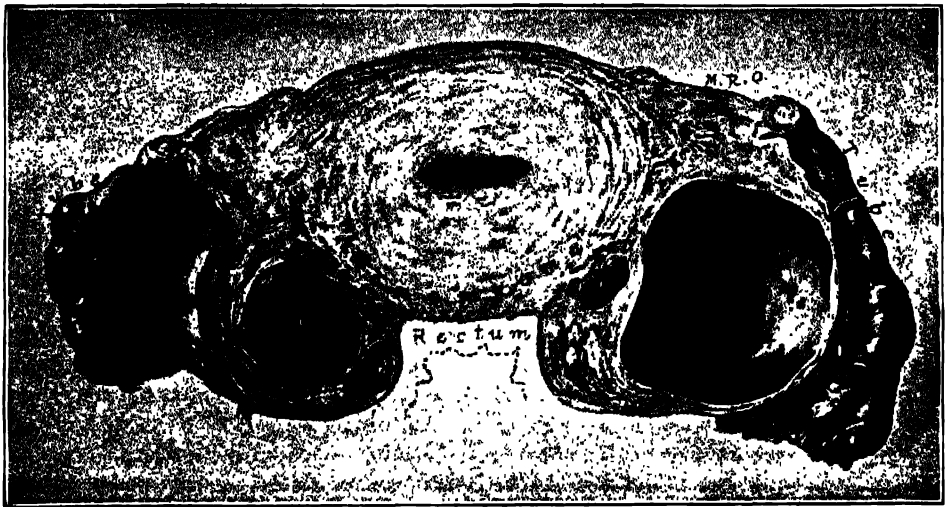
Fig. 989.—Pelvic endometriosis. Cross-section of the uterus and ovaries indicating the condition found at operation. Both ovaries were adherent to the posterior surface of the uterus and the implanted endometrial cells have grown into the uterine wall, forming superficial adenomyosis. Sections of the uterine wall showed no endometrial tissue between this area and the normal endometrium. The larger cavity in the right ovary is a simple follicular cyst. (Sampson—*Arch. Surg.*)

tissue are found where one would expect them if they were secondary to endometrial spill from the tubes, (c) endometrial tissue has been successfully transplanted in the peritoneal cavity of animals (Jacobson, and Crossen and O'Keefe), (d) blood has been observed coming from the fimbriated end of the tube at operation, and (e) the tissue seems to menstruate with each period similar to endometrial tissue, indicating that it is real endometrial tissue.

The arguments against this theory are: (a) tissue from the menstrual discharge in monkeys is desquamated dead tissue and will not grow in the peritoneal cavity of the monkey, even when a uterine fistula is made so that the menstrual flow empties directly into the peritoneal cavity (Heim), (b) this theory does not explain aberrant endometrial tissue occurring in distant structures, for instance, in the umbilicus or the inguinal canal, and (c) it does not explain such tissue found in the depth of the ovary without surface contamination.

Fig. 990.
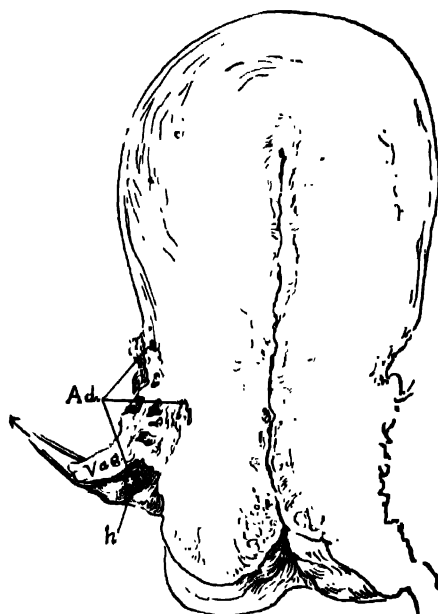
Fig. 991.

Figs. 990 and 991.—Endometrial cyst of ovary. Fig. 990, A small cyst of the left ovary has perforated and become adherent high up to the round ligament. The omentum also is adherent over it. On separating the adhesions, dark chocolate-like fluid escaped. Fig. 991. Section of the cul-de-sac area in the same case. Gravitations of leakage material have caused an implantation endometriosis at the bottom of the cul-de-sac. A small, blood-filled cyst of this endometriosis of the rectovaginal septum may be seen projecting into the vaginal cavity at the posterior vaginal vault. Compare with Fig. 992. (Sampson—*Arch. Surg.*)

2. Heteroplasia of the serosa or celomic epithelium (Iwanoff, Meyer, Fischel, Novak). This theory of the origin of endometrial cysts of the ovary is based on the embryologic fact that the lining mucous membrane of all parts of the müllerian canal (tubes, uterus, vagina), as well as the germinal epithelium covering the ovary, and the pelvic peritoneum, are all derived from the same parent tissue, namely, the celomic epithelium. The müllerian mucous membrane in all its varied forms is merely an invagination of the celomic epithelium, showing varying degrees of differentiation according to its location. Some of the less highly differentiated portions retain the power of further differentiation later in life, so that they may, under the influence of unknown stimuli, develop into differentiated tissue, such as tubal mucosa or endometrium. Whether this stimulus is of endocrine origin or whether it is due to some substance coming from the tubal ostium is still undecided. Also, there is the unsolved question as to whether all peritoneal cells or only certain ones, such as the "basal" cells (Meyer), have the power of differentiating.

In favor of this theory is the fact that it offers an explanation for all forms of endometriosis, for it is well known that remnants of peritoneal epithelium are frequently

present in the inguinal canal and in the umbilicus. Against this theory must be counted the fact that the adequate stimulation is still unknown. Also, the known tendency to wide vascular dissemination of bits of tissue from the uterus, particularly during pregnancy, might account for subsurface endometriosis in various situations.

Other theories have been suggested, namely, metaplasia of the lymphatics (Schiller) and metastases by way of the lymphatics or the blood stream (Halban, Mestitz). The distribution of the lesions practically excludes the lymphatic or blood stream metastases, and if the other method (metaplasia) does occur, it is very rare.

Fig. 992.—Endometriosis of rectovaginal septum, with coincident endometriosis of the sigmoid flexure which almost completely blocked the bowel. The insert at the upper right corner gives an excellent reproduction of the appearance through the vaginal speculum. (Cullen —*Arch. Surg.*)

Sampson does not hold that the transtubal transplantation is the only etiologic factor in endometriosis, but that it is the most important factor in causing the common clinical type. His indefatigable search for factual knowledge of this serious disease has resulted in one of the most comprehensive and helpful and beautifully illustrated studies in the history of medicine.

In a recent paper on the development of the implantation theory for the origin of peritoneal endometriosis he gives the following summary:

In studying the pathogenesis of ovarian and other forms of peritoneal endometriosis, one must not lose sight of the important role evidently played by patency of the tubes.

At times, during menstruation, blood, carrying bits of Müllerian mucosa, escapes through patent tubes into the peritoneal cavity. This blood may come either from the uterine or from the tubal mucosa. Circumstantial evidence indicates that Müllerian tissue

Fig. 993.—Remote results of an endometrial cyst of ovary. Patient aged twenty-five years, suffered at menstruation with pain in rectum and radiating down left thigh to knee. Trouble persisted. At operation, August, 1914, a cyst of the left ovary, size of an orange and filled with old blood, was removed. Some blood free in cavity. (Cyst had evidently perforated long ago with the formation of implantation endometriosis in cul-de-sac.) Some temporary relief from operation, but in February, 1916, polypi appeared at the vaginal vault, connected with an induration in the rectovaginal septum. Polypoid masses were removed but recurred, and microscopic examination showed them to be endometriosis. Operation in November, 1916, revealed the condition shown in the above drawing. The endometriosis of the rectovaginal septum had extended into the parametrium, constricting the ureters until they were both dilated as here shown. Uterus was removed but not all of the rectovaginal growth could be removed. Later, radium treatment. Improvement. July, 1917, patient was doing well, no pain in kidney regions. (Cullen—*Bull. Johns Hopkins Hosp.*)

in this blood, under favorable conditions, becomes implanted on any structure upon which it may lodge. These early primary implants occur most frequently in close proximity to the distal ends of the tubes, such as the lateral and under surfaces of the ovary, the lower portions of the posterior surfaces of the uterus and broad ligaments, and the bottom of the cul-de-sac. They may be present only on the ovary or ovaries, only on the peritoneum, or in both situations. Some of these implants remain small and superficial. The Müllerian mucosa in others invades its host much like implantation carcinoma. When it invades other organs or structures than the ovary, a type of endometriosis arises which both grossly and histologically often closely resembles a direct endometriosis of the uterine wall.

The invasion of the ovary by Müllerian mucosa implanted on its surface and the conditions resulting from it are in many ways similar to those arising from the invasion of the other organs and structures by this tissue except for one very striking difference. The ectopic endometrial cavities distended with menstrual blood in endometriosis, in other situations than the ovary, are usually small while those in the ovary frequently attain a large size, forming the well-known endometrial cysts of that organ. Whether small or large these ovarian cysts often rupture and some of their contents escapes into the peritoneal cavity frequently causing adhesions and additional implantations. In patients with peritoneal endometriosis associated with an endometrial cyst of the ovary, both primary implants from or through the tubes and secondary ones from the cyst may be present.

The study of peritoneal endometriosis also indicates that menstrual blood may not only escape from foci of endometriosis in other situations than the ovary, but adhesions and an additional spread of the endometriosis (secondary implants) may arise from this source. On account of the usual small size of the superficial foci of serosal endometriosis, the results of their participation in menstruation are not as striking as those which take place in the ovarian cysts.
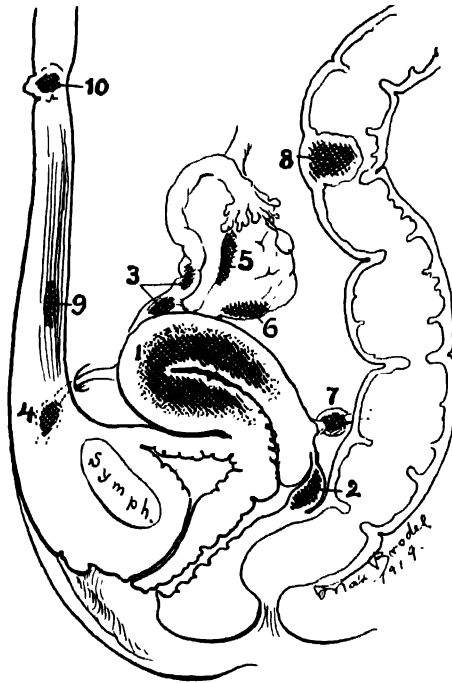
Fig. 994.--Sites at which endometriosis has been found. 1, Uterus; 2, rectovaginal septum; 3, tube; 4, round ligament; 5, ovary; 6, uteroovarian ligament; 7, uterosacral ligament; 8, sigmoid flexure; 9, rectus muscle; 10, umbilicus. As explained at the beginning of the chapter, when endometriosis occurs in a muscular structure, it is called adenomyosis, and if such growth develops in a way to form a distinct tumor it is called an adenomyoma. (Cullen—Arch. Surg.)

If bits of Müllerian mucosa carried by menstrual blood escaping into the peritoneal cavity are always dead, the implantation theory, as presented by me, also is dead and should be buried and forgotten. If some of these bits are even occasionally alive, the implantation theory also is alive.

The viability of this theory is of secondary importance to me as compared with the pleasure and the increased knowledge of this and kindred subjects which I have gained in these studies and the resulting more intelligent treatment of patients who have peritoneal endometriosis. There are many other interesting unsolved problems associated with the pathogenesis and life history of endometriosis of all types.

Since the attention of the profession has been drawn to the occurrence of this condition, it has been found to be fairly frequent. This process varies in extent from tiny "spots" on the surface of the ovary to tumors as large as a uterus at the sixth month of pregnancy. Usually these cysts are ruptured in removal, the reason being that the adherent structure comes in time to form a part of the wall of the cavity, and the cavity is necessarily opened when the separation is made. These cysts contain a thick chocolate-colored liquid, hence the term "chocolate cysts."

The epithelium lining these cysts varies a great deal. In some specimens the epithelium is strikingly similar to that of the endometrial glands. These glands are also surrounded by stroma similar to endometrial stroma. In other specimens the epithelium is not at all typical of endometrial glands, and indeed may resemble epithelial cells from any part of the body. Also, the stroma may be very scanty or missing entirely. There is usually evidence of old blood in the cavity and walls of these cysts. Figs. 985 and 986 show typical characteristics of the endometrial cyst. The leaking cyst contents may gravitate to the posterior peritoneal cul-de-sac, where they form strong adhesions and ingrowths, binding the rectum to the posterior surface of the uterus. The various resulting conditions are shown in Figs. 987 to 994.

The dense adhesions to the small intestinal coils and sigmoid and rectum and other structures seriously complicate the operation for removal. The early perforation with adhesions and the chocolate-like contents are the striking clinical features of these cysts, and Sampson designated them as "perforating hemorrhagic cysts" and also as "chocolate cysts." As the essential pathologic feature is the endometrial tissue in the wall, the term "endometrial cyst" has now been widely adopted. As previously mentioned, in many cases the aberrant growth of endometrial tissue is not confined to the ovarian cyst, but spreads to various other structures throughout the pelvis. This condition of widespread growth of aberrant endometrial tissue is appropriately designated "pelvic endometriosis."

Considered clinically pelvic endometriosis constitutes one of the very serious diseases of the childbearing period—serious on account of the recurring pain and disability, and serious because of the complications frequently increasing the danger of operative relief.

A type of endometriosis of particular interest to the surgeon is that due to operative implantation of endometrial cells or to operative creation of an avenue for implantation, as when a tubal stump is left uncovered. The fact that there have been a number of endometriosis lesions clearly due to this cause has a bearing also on the etiology of the other lesions.

Diagnosis.—In the first place, endometriosis is a disease of the age of ovarian activity, for its development and progress are dependent on the same ovarian hormones that cause the normal menstrual changes in the uterine endometrium. As the initial lesions are minute and their progress slow, it probably takes several years for the process to reach the stage of clinical symptoms. Consequently the lesions which have advanced sufficiently to cause pain and disability are found principally in individuals from thirty to forty-five years of age.

The frequency of this disease is rather startling. Sampson found it in 43 per cent of abdominal operations in patients between the ages of thirty and fifty. However, in some of these cases, operated on for other conditions, the endometrial involvement was very slight. In estimating the probable number of individuals with aberrant endometrial tissue in the pelvis, we must consider also the probable large number of persons in whom the involvement is so slight or so quiescent that it does not give rise to symptoms requiring them to consult a physician. Our present knowledge indicates that the smaller lesions are very erratic and uncertain in growth and may remain quiescent indefinitely.

Even with the progressive lesions there may be but few symptoms. It is surprising what extensive adhesions may form without symptomatic disturbance. For example, an ovarian cyst that has given the patient very little discomfort may at operation show extensive and dense adhesions. On the other hand, some patients suffer much pain and disability, the progressive pathologic process giving rise to marked symptoms and examination signs.

The bedside recognition of pelvic endometriosis is not as easy as might be inferred from the clear-cut pathologic changes. The difficulty in diagnosis comes from the fact that, though there may be definite symptoms and examination signs, these same symptoms and signs occur in other more common diseases. Consequently, the more common disease is usually decided on as the diagnosis, and endometriosis is encountered unexpectedly at the operation.

It may be said in a general way that endometriosis gives rise to the symptoms of chronic inflammation, without the infection and pus formation. There is the fixation of structures and induration and tenderness, and usually a definite mass as in inflammation. There is exacerbation of the pain and distress at the menstrual time with subsidence between, as often happens in chronic pelvic inflammation. So closely does the symptomatic picture resemble chronic inflammation, or a tumor with inflammation, that such diagnosis is usually made.

If, however, we forego the hazardous practice of jumping at a diagnosis from one or two prominent symptoms, and take the trouble to make a critical analysis of the features of the clinical picture, we are likely to notice some things about the case that do not fit in with a purely inflammatory condition. Such anomalous symptom or sign arouses suspicion that we are dealing with something more than inflammation or perhaps something entirely different.

The following are the items likely to arouse such suspicion:

1. *Absence of Definite Evidence of Infection.*—As the patient tells her story of pain and disability with fairly comfortable intervals, we naturally think of chronic pelvic inflammation. But when the attempt is made to determine the time of infection and its character, we are not successful. The history gives no definite indication of gonorrheal infection nor of puerperal infection. The objective findings also include nothing that might not be due to noninflammatory irritation and infiltration. There is no telltale focus of chronic inflammation in the vulvovaginal glands or in Skene's glands or in the cervix. There is nothing in the temperature or leucocyte count definitely indicating infection. We are speaking of uncomplicated endometriosis. Of course, a patient may have infection along with endometriosis, in which case the symptoms of both diseases will be present.

2. *Fixation Without Evident Cause.*—As mentioned under Pathology, fixation of adjacent structures by ingrowths is a marked feature of endometriosis. This may take place so gradually and with so few symptoms that it is encountered as a surprise at the examination. When extensive fixation is found in the pelvis without a history of inflammation or preceding operation, endometriosis is to be suspected.

One very common form of this fixation is adherent retrodisplacement. There may be simply the fixation of the retrodisplaced uterus or there may be also the characteristic infiltration of the cul-de-sac area under the displaced uterus. This infiltration if at all extensive is likely to present a nodular ''shotty'' feel due to irregular islands of epithelial growth. When the areas of endometrial growth advance to the stage of menstruation, small collections of blood form in them. These feel hard at first but as they become larger or nearer the vaginal surface, their cystic character may be recognized.

Another form of fixation is adherent ovarian cyst. A small or medium ovarian cyst, which should be freely movable in the absence of inflammation, is found adherent, without any history of infection or other adequate cause for the fixation.

3. *Disproportion Between the Pain and the Palpable Lesion.*—This disproportion may be in either direction. As previously mentioned, there may be no pain or history of disability, in spite of the fact that examination shows a marked lesion with extensive fixation. This in itself indicates that the fixation is due to some process different from inflammation.

On the other hand, there may be marked pain and disability, much more than to be expected from chronic inflammation without abscess formation. In endometriosis marked pain is usually due to tension from extrusion of blood into a filled cavity or to peritoneal irritation from leakage. Consequently it presents certain characteristics, which are taken up later.

The important feature here emphasized is that the pain bears no definite relation to the size of the mass, often being very severe with only a small mass. In fact, severe pain has been reported in cases of endometriosis not yet advanced sufficiently to give any palpable mass. On this account, endometriosis is recognized as one of the causes of dysmenorrhea without palpable lesion—the diagnosis depending on the time and character of the pain.

4. *The Time and Character of the Pain.*—Keeping in mind the pathology of the disease, the characteristic feature being a closed sac with menstruating endometrium, the relation of the pain to menstruation becomes clear. It starts with the premenstrual swelling some days before menstruation and continues severe till practically the end of menstruation. The pain from tension of the sac will continue as long as additional blood is being extruded into the sac from the aberrant endometrial tissue lining.

With a chronic inflammatory mass or a tumor, the discomfort is likewise more marked at the menstrual time, but there is a difference in two particulars. First, the pain of ordinary menstrual swelling about an inflammatory mass or tumor usually becomes less as the flow is well established, while the pain of endometriosis is likely to continue severe all through the flow. Again, with ordinary menstrual swelling, the discomfort is only moderate and is diminished by rest and other measures that diminish general pelvic congestion, whereas the pain of endometriosis may be severe in character and persistent in duration in spite of palliative measures.

In cases of obstructive dysmenorrhea from cervical stenosis the pain may be very severe, but it comes only with the onset of the flow and disappears as soon as the flow is well established. Also, it is likely to be more intermittent and cramp-like than the persistent pain of increasing tension in a closed cavity. Again, dysmenorrhea from cervical obstruction usually dates from the first menstruation, whereas that from endometriosis is an acquired dysmenorrhea coming on later.

5. *Miscellaneous Points.*—In regard to the history, sterility, rectal pain, and dyspareunia are of rather frequent occurrence in endometriosis.

The *sterility* may have been absolute or there may have been children years before. Usually several years have elapsed since the last pregnancy. Evidently impregnation is interfered with in endometriosis a long time before the process reaches the stage of pain and disability that calls attention to it.

The incidence of *rectal pain* or pressure discomfort is due of course to the frequent involvement of the cul-de-sac area. When the cul-de-sac endometriosis extends to the connective tissue and the rectal wall, there is very likely to be deep rectal discomfort, off and on, especially at the menstrual time.

Occasionally *dyspareunia* appears, and gradually increases. This pain in coitus is more likely to be present when endometriosis involves the cul-de-sac area, though it may be absent

with extensive involvement of this region. Dyspareunia due to endometriosis appears without any apparent cause, such, for example, as infection. It is usually slight at first and increases gradually with the increasing infiltration and fixation of the tissues about the cervix. It is likely to vary considerably at different times, being most marked usually near menstruation.

In addition to the special points in the history there are also certain special examination findings that are frequently associated with endometriosis.

Cul-de-sac infiltration, causing palpable induration of the vaginal wall just back of the cervix, is a distinctive feature in certain cases of endometriosis. Involvement of the vaginal wall in this situation in the childbearing period is nearly always due to pelvic endometriosis or to inflammation. Consequently if infection can be excluded, endometriosis becomes probable. This probability is increased if there is evidence of endometrial involvement higher in the pelvis. In some cases the process in the posterior vaginal wall goes on to the formation of distinct "shotty" nodules. If these approach the surface so that the bluish color of the contained blood can be seen in the speculum examination (Figs. 991, 992), the diagnosis becomes positive.

Retrodisplacement of the uterus is found in a large proportion of cases of endometriosis. This may be because retrodisplacement favors the development of endometriosis or because endometriosis adhesions tend to pull the uterus into backward position. Perhaps both factors enter into the matter—the first in some cases and the second in other cases. At any rate, adherent retrodisplacement is found so frequently in endometriosis that that disease is to be suspected, especially if there is no history of infection to account for the fixation of the displaced uterus.

Fibroid tumor in the uterus is a common finding. Such a nodule may be an ordinary encapsulated myoma or it may be an adenomyoma. Endometriosis is to be suspected in any case of small uterine myoma with marked fixation without a history of infection.

An *associated endometrioma* of the umbilicus or of the inguinal region or in an abdominal-operation scar indicates the nature of the process going on deeper in the pelvis.

Occasionally *cystoscopic* examination will show the characteristic small blood cysts in the bladder wall. Such an examination is especially helpful in differentiating between endometrial infiltration and carcinomatous infiltration in patients approaching the menopause.

Proctoscopic examination is useful in patients with perirectal involvement. The induration from involvement of the culdesac and rectovaginal septum may bring up the question of carcinoma of rectal origin. In endometriosis proctoscopic examination will show normal rectal mucosa, except where the hemorrhagic cystic process has extended through the rectal wall.

In addition to differentiation from ordinary chronic inflammation, pelvic endometriosis must be differentiated from a tumor with complicating inflammation, from pelvic tuberculosis, and from ectopic gestation.

Treatment.—The treatment of pelvic endometriosis is based on the general principles of treatment of nonmalignant conditions—that is, conservative treatment when that gives sufficient relief, and radical treatment if serious symptoms persist. Minor degrees of endometriosis may pass unnoticed or give rise to only moderate dysmenorrhea relieved by sedatives. Hirst reports that large dosage of testosterone gave decided improvement, even to reduction in size of troublesome masses. The radical measures available are operation and irradiation.

Operation.—A mass in the pelvis causing persistent pain and disability in spite of conservative measures should ordinarily be removed, whether it is endometriosis or chronic inflammation or a new growth. Usually there is some question as to the exact nature of the mass until the abdomen is opened and the diseased area subjected to inspection and direct palpation.

The most important points to settle before deciding on operative treatment are: first, that there is a definite pathologic process not sufficiently relieved by palliative measures, and second, that the persisting pain and disability are serious enough to warrant the risk of an operation. In such a case if the patient is in good general condition, operative removal of the enlarging mass should be carried out promptly before some local or general complication increases the hazard.

Endometriosis is dependent on ovarian activity, and ablation of ovarian influence ordinarily stops the process. Then why not eliminate ovarian activity by irradiation (radium or x-ray), instead of subjecting the patient to operation? Operation is ordinarily better than irradiation for three reasons: first, to preserve ovarian activity if possible; second, to eliminate malignancy; and, third, to eliminate a mass causing pressure disturbance.

Preservation of Ovarian Influence.—In the childbearing period it is important to preserve ovarian activity. Though the condition appears to be endometriosis, it may be found at operation to be chronic inflammation or ectopic gestation or a new growth, any one of which could be removed and leave ovarian influence intact.

Even if the pathologic process proves to be endometriosis, it may be limited to structures that can be removed and still preserve ovarian tissue. An involved corpus uteri may be removed by supravaginal hysterectomy. Endometrial ovarian cysts can sometimes be removed with preservation of an uninvolved portion of an ovary. In a patient under thirty-five years of age it is worth some risk to preserve ovarian influence for the several years still remaining before the natural menopause. If the small areas of endometriosis left at such operation should show serious activity later, the ovarian influence may then be eliminated by irradiation.

Elimination of Malignancy.—This indication for operation assumes importance in patients approaching the age of forty. There is necessarily some uncertainty as to the nature of the process going on in the mass. The supposed endometriosis mass may be malignant, either primarily or as a later complication. In either case it is advisable that positive knowledge be acquired promptly, and also that the tumor be removed if practicable.

Elimination of Mass.—In well-marked endometriosis there is usually a mass causing pressure disturbance. It may be in the form of an ovarian cyst or it may be a uterus enlarged by adenomyoma. In either case the abnormal structure is likely to cause troublesome symptoms as long as it remains, hence the preferable plan of treatment is ordinarily that which removes the mass.

Irradiation Treatment.—Irradiation by radium or x-ray stops ovarian function and thus checks the recurring menstrual exacerbation and progress of the endometriosis. It does not remove the ovarian cyst or other mass, which in itself may keep up discomfort and disability. However, irradiation may be useful in the following two classes of cases.

Poor Operative Risk.—In a person seriously handicapped from the operative standpoint, irradiation may be used to check the increasing pain and disability from endometriosis. This applies especially of course to patients approaching the menopause, in whom the continuation of ovarian activity is not so important as in earlier life.

The preferable form of irradiation to employ depends on the particular conditions present. When the endometriosis is principally in the uterine wall (adenomyoma) a radium application within the uterus is the best plan, because concentrated irradiation is given at the seat of the process and without the extensive intestinal irradiation occasioned by x-ray. Also, radium application in the uterus works in well with diagnostic curettage which is needed to exclude malignancy and which may be carried out at the same time. On the other hand, if the endometriosis is scattered widely in the pelvis and unaccompanied by uterine bleeding indicating curettage, deep x-ray therapy is the preferable form of irradiation.

Irradiation treatment is employed on a tentative basis. It may give sufficient relief in a case of endometriosis, and it may not. Also, the possibility of an error in diagnosis is to be kept in mind, and if satisfactory result is not secured by irradiation in a reasonable time, operation is again to be considered.

Postoperative Activity.—When activity persists in an area of endometriosis after operation, irradiation treatment is to be employed. In some cases where it was thought best to leave an ovary, there may be new development of endometriosis or renewed activity in some small area left. Occasionally there is persistent activity even when both ovaries have been removed along with the endometrial cysts. In either case irradiation treatment is to be employed.

The following is a case in point. A patient, aged forty-six years, was sent to us by a general surgeon on account of uterine bleeding and an increasing pelvic mass which appeared some months after an abdominal operation which he had performed for her. Both the patient and the surgeon were considerably alarmed on account of the possibility of malignancy. The operation, four months before, was appendectomy and removal of an ovarian chocolate cyst with preservation of the other ovary. The patient recovered without disturbance and had two normal menstruations, and then the bleeding started.

Examination showed a firm, fixed mass the size of a small fist occupying the central pelvis. The mass seemed to be mostly enlarged uterus with surrounding adhesions. A diagnosis of endometriosis with adenomyoma of the uterus was made, and we decided on radium treatment for the adenomyoma with curettage to exclude malignancy. This treatment stopped all ovarian activity, and later the enlarged uterus diminished in size considerably.

In other cases of postoperative activity, with predominating peritoneal and connective tissue involvement instead of uterine, x-ray treatment was the form of irradiation used to stop the advancing endometriosis.

Special Dangers.—Experience has shown that operation for pelvic endometriosis carries certain special dangers. These dangers are due to the extensive dense adhesions caused by the unusual process. These adhesions are not simple agglutination of surfaces, as in inflammation, but real tissue ingrowths into the walls of adjacent structures, such as small intestine, sigmoid, and rectum. The two special dangers are, first, a tear into the bowel and, second, postoperative intestinal paralysis and peritonitis.

Injury to Bowel.—In endometriosis the adherent walls are fused by tissue growth and cannot be separated easily, as can inflammatory adhesions. Any attempt to separate them carries danger of a tear into the intestinal tract. This fact must be kept in mind in trying to enucleate the mass to be removed. Rough or hurried separation by palpation only is to be avoided, as the line of cleavage may extend into the bowel lumen. Dense adhesions should be carefully separated under sight as well as touch, and the line of separation should not be allowed to encroach on the intestinal wall.

It is important also to limit the separation as much as possible, breaking adhesions only where necessary to allow safe removal of the abnormal mass. The cyst wall should be removed as far as practicable, especially the endometrial lining. It is permissible to leave some of the outer layer of the cyst wall, if necessary for the safety of the intestine or other attached organ.

In cases requiring removal of the uterus, the adherent rectum can usually be separated down far enough to permit supravaginal hysterectomy. An attempt to separate dense adhesions in the cul-de-sac sufficiently low to allow complete hysterectomy may cause a tear into the rectum. It is safer as a rule to leave the cul-de-sac adhesions and the cervix. If there should be a complicating cervicitis that persists, the cervix may be coned later from below.

Postoperative Peritonitis.—Another serious problem presented by these cases of endometriosis is to get the patient through the postoperative stage without intestinal paralysis and peritonitis. Just what factor it is that makes these patients so prone to postoperative intestinal paralysis and peritonitis is not altogether clear, for there is no primary infection. A plausible theory is that the extensive damage to the intestinal walls first interferes with peristalsis, causing postoperative intestinal paralysis, and second, favors escape of colon bacilli into the damaged area, causing peritonitis. Whatever the cause, the tendency to fatal postoperative peritonitis is painfully evident to those engaged in treating these pa-

tients. Several trying experiences in the handling of these cases convinced us that this disease constitutes one of the most serious pelvic conditions for which operation is required in the childbearing period.

The first of these experiences is recalled vividly because of the many days of anxiety before the patient was past the acute danger, and also because of the difficulty encountered later in closing the intestinal opening which had been made for drainage during the intestinal paralysis. At the primary operation typical endometriosis was found, with dense adhesions and the ''chocolate'' contents leaking from the cyst. There was no pus and no evidence of infection, consequently no drainage was employed, the abdominal wound being closed entirely as in all noninfected cases. In the next few days the patient developed intestinal paralysis with persistent reverse peristalsis and fecal vomiting. This was finally overcome by opening the distended intestine and draining away the contents. This maneuver permitted use of the stomach and upper intestine for purposes of nourishment. The postoperative course constituted a long hard siege, but the patient survived the acute symptoms and the intestinal tract finally resumed its normal function. Then came the problem of closing the large artificial fistula remaining from the intestinal drainage. This proved difficult but was finally accomplished, and the patient eventually made a complete recovery.

In the second experience a young married woman, in good general health, had a painful pelvic mass requiring operation. The operation revealed bilateral ovarian cysts with extensive adhesions and ''chocolate'' contents. There was no pus and no evidence of infection. The cysts were enucleated, and the abdomen was closed as usual. After operation intestinal paralysis and a low-grade peritonitis developed. The peritonitis increased, an acute nephritis developed, the patient went from bad to worse, and finally died in spite of peritoneal drainage and intestinal drainage and everything else that was done.

In studying over these two experiences the decision was reached to drain all cases of extensive endometriosis or of extensive adhesions suspicious of endometriosis, and this plan has been followed since with satisfaction. The results have been so uniformly good that since adopting drainage these cases are not dreaded, as they formerly were.

Not long after adopting the drainage rule in these cases, the senior author was called hurriedly one night to a hospital to see in consultation a patient who was then dying of peritonitis. A young married woman of prominent family had been subjected to operation for a troublesome pelvic mass. No pus was found and after the intra-abdominal work was finished the abdomen was closed with expectation of prompt recovery. The development of fatal peritonitis was a great surprise and shock to all concerned. Inquiry revealed that extensive dense adhesions were encountered in the operation and also some cysts having typical ''chocolate'' contents.

In another instance, happening to meet a colleague in one of the hospitals, he inquired abruptly, ''Do you drain in all cases of endometriosis?'' On replying, ''In all cases of any extent,'' he stated, ''I wish I had,'' and then related the details of a case of endometriosis in which the patient had just died of postoperative peritonitis.

CHANGES DEPENDENT ON ENDOCRINE DISTURBANCE IN DISTANT ORGANS

Occasionally marked changes in the structure of the ovary are brought about by altered endocrine activity in a distant organ or by a growth in the distant organ causing an upset in the normal endocrine balance. There are two main types of such changes found in the ovary: the theca-lutein cysts and follicular atrophy.

Theca-Lutein Cysts

Etiology.—It is now well known that hydatidiform mole, chorioepithelioma, or adenoma of the pituitary can cause marked enlargement of the ovaries, due to the formation of multiple theca-lutein cysts. Excess of anterior pituitary hormone is the fundamental cause.

Pathology.—These cysts are almost always found in association with hydatidiform mole or a chorioepithelioma. The abnormal pregnancy causes a marked increase in the amount of the gonadotrophic hormone in the body. This in turn causes a marked increase in the number and size of the follicles in the ovary so that the ovary may become very large. In one of our cases the ovaries filled the pelvis and lower abdomen. Most of these follicles become luteinized but fail to rupture. Fig. 995 shows theca-lutein cysts of the ovary resulting from a chorioepithelioma of the uterus. The ovaries are studded with thin-walled cysts of different sizes. These enlarged ovaries resemble the ovaries of experimental animals that have been given large amounts of the pituitary-like hormones from the urine of pregnancy.

Fig. 995.—Bilateral theca lutein cysts of the ovaries associated with a chorioepithelioma. Gyn. Lab.
(This specimen reached the laboratory through the kindness of Dr. George Ives, who has added to our teaching collection a number of instructive specimens contacted in his work in pathology.)

Microscopic.—The cysts are found to be lined with lutein cells. These may be derived from the granulosa layer or from the theca interna or from both.

Diagnosis and Treatment.—The diagnosis is made on the history and progress of the case, together with various laboratory tests as outlined below.

An abnormally rapid increase in the size of the uterus during pregnancy together with rapid enlargement of the ovaries should lead one to suspect this condition. Bleeding usually occurs as an early sign. If minute cysts are passed and microscopic examination shows them to be dropsical villi, the diagnosis is confirmed. An Aschheim-Zondek test which is positive in high dilutions is suggestive, but it must be remembered that multiple pregnancy will give the same findings, due to the extra amount of placental tissue present. An x-ray is of no value under three months and a negative result even at four months is not conclusive as to the presence or absence of a fetus.

The immediate treatment, when the diagnosis is positive, is interruption of the abnormal pregnancy by emptying the uterus. The elimination of the pathologic process in the uterus may cause the ovarian cysts to subside and the ovaries to return to normal. If a chorioepithelioma is found, a complete hysterectomy and bilateral salpingo-oophorectomy followed by deep x-ray therapy is indicated as explained in Chapter IX.

Follicular Atrophy

This condition may be secondary to hyperplasia or adenoma of the adrenal cortex, basophilic adenoma of the hypophysis, or pineal tumor. The exact mechanism causing the serious ovarian changes is still under discussion. Cushing
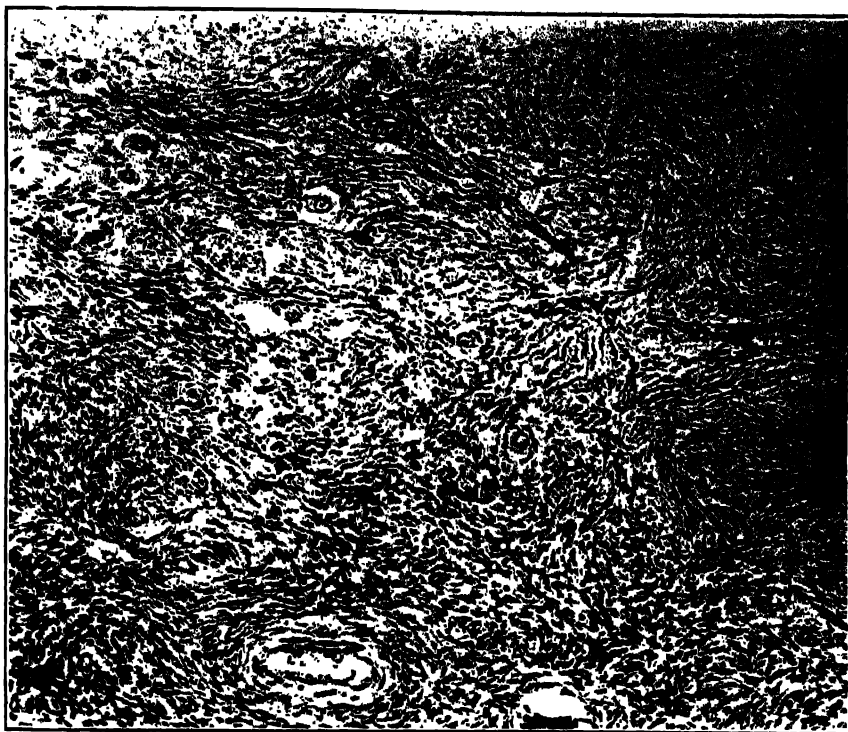
Fig. 996.—Atrophy of the follicular apparatus of the ovary due to hyperplasia of the adrenal cortex. Patient, aged nineteen years, had had amenorrhea for six months and was developing masculinity. Compare this atrophic follicular zone with the same area in a normal ovary (Fig. 10). The facial hirsutism in this case is shown in Fig. 997. Gyn. Lab.

felt that they are caused by the primary altered function of the pituitary due to the tumor composed of functioning basophile cells. Goldzieher and Koster, in discussing adrenal conditions, feel that in many of the cases the primary condition is one of adrenal hyperplasia or tumor. It is well known that basophilic adenomas are associated with marked hyperplasia of the adrenal as well as with hyperplasia of other endocrine organs, but whether the pituitary is the primary cause of the changes found has been questioned by many. An interesting discussion of various points is given under "Dyspituitarism" by Cushing, in the Harvey Lectures of 1932-1933, and under "Adrenals" by Goldzieher and Koster.

Novak reports extreme atrophy of the ovary with disappearance of the follicular apparatus in a case of adrenal cortex hypernephroma. In one of our cases of amenorrhea and developing masculinity, there was adrenal cortex hyperplasia. The ovaries were somewhat enlarged with atretic follicular cysts, but the microscopic picture (Fig. 996) indicated serious disturbance of the follicular apparatus tending toward destruction. Compare this dense ovarian

Fig. 997.—Hypertrichosis on the face in a patient of ours who had a hyperplasia of the adrenal cortex.
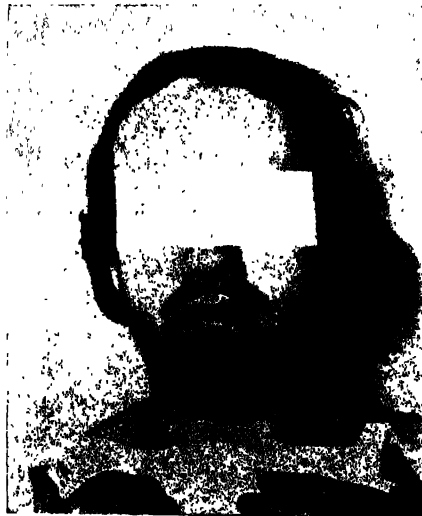
Fig. 998.—Extreme facial hirsutism in a case of female pseudohermaphroditism due to adrenal cortical hyperplasia, as was later demonstrated by autopsy. (Novak—*Am. J. Obst. & Gynec.*)

cortex, showing only a few remnants of the follicular apparatus, with the normal ovarian cortex of childhood in Fig. 10, showing the usual abundance of functionating elements. The clinical symptoms corresponded with the follicular atrophy. The menstrual flow had gradually diminished, and had been entirely absent for the last six months. There were definite developments toward masculinity, consisting of appearance of hair generally, pubic hair extending upward toward umbilicus, hair on the face (Fig. 997), and hypertrophy of the clitoris toward the male type of glans. Fig. 998 shows very marked facial hirsutism in a case of adrenal hyperplasia.

OTHER BENIGN GROWTHS

Under this heading are grouped the proliferating cystadenomas (pseudomucinous and serous) and the simple solid tumors—fibroma and myoma.

PROLIFERATING CYSTS

Proliferating cysts are the ovarian tumors which attain such a large size. This is the form of growth ordinarily referred to when an "ovarian cyst" or "ovarian tumor" is spoken of.

The term "proliferating" is given to these growths because they have the faculty of generating new cysts within the original cyst or on the outside of it. They increase in size persistently, and there is no means of stopping their growth, except removal.
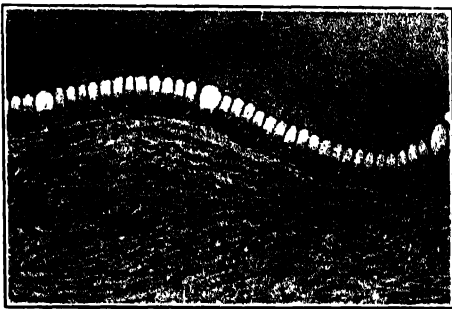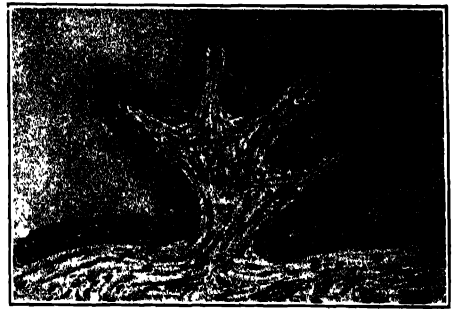
Fig. 999.   Fig. 1000.

Figs. 999 and 1000.—Indicating the difference between the cells lining a pseudomucinous cyst (Fig. 999) and those lining a serous cyst (Fig. 1000), as explained in the text. Columnar cells, nonciliated containing pseudomucin. Goblet cell present.

Pathology

The proliferating cysts, or cystadenomas, are of two kinds—the pseudomucinous and the serous.

Pseudomucinous Cystadenomas.—This form of tumor is known also as "paramucinous cystadenoma" and as "cystadenoma evertens." In these cysts the contents consist of a jellylike material which is secreted by the epithelial cells lining the cyst. This gelatinous material is the distinguishing characteristic of the pseudomucinous cystadenoma (Figs. 999 to 1003). On chemical examination it shows the reaction for paramucin or pseudomucin (not precipitated by acetic acid, but precipitated by alcohol as delicate threads, which

are insoluble in water; mucin is precipitated by acetic acid, and albumin is precipitated by heat). The color of this gelatinous material depends on the amount of blood coloring which has diffused through it from hemorrhage into the cyst, as explained later.

As the contents are formed by the secretion of the cells lining the cyst, there is a constant increase in the amount, and this causes constant internal pressure, which keeps the wall of the cyst tense. In this way the epithelial layer is kept spread out and does not usually pile up along the wall in the form of papillary projections. Rather the pressure tends to depress portions of the wall, and as the epithelial cells multiply they are pushed farther out in the wall in the form of glandlike depressions, hence the name "evertens." The depressions may become occluded at the neck and are thus cut off from the main cavity forming secondary cysts (Fig. 1001). These secondary cysts are found in great numbers about the primary cyst and occasionally one or more of the secondary cysts may become as large as the primary one.

A.   B.
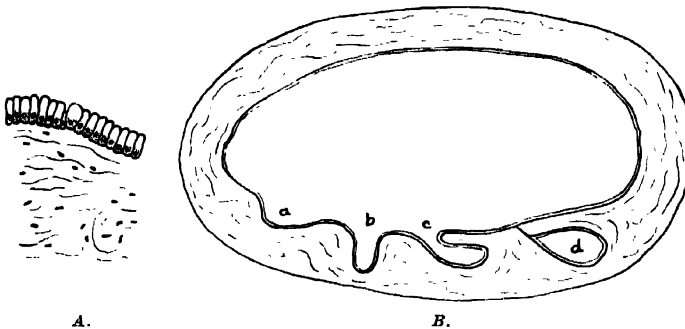
Fig. 1001.—*A*, High power microscopic field showing the type of cells lining a pseudomucinous cyst. *B*, Illustrates the process by which secondary cysts are formed. (Crossen and Crossen—*Synopsis of Gynecology*.)

The rule that pseudomucinous cysts are evertent is not absolute. In nearly all such cysts there are a few insignificant epithelial ingrowths, and in rare cases these growths may predominate, giving a distinct character to the growth (pseudomucinous cystadenoma invertens). Such atypical pseudomucinous cysts are nearly always small, indicating that there was not much internal pressure.

The tumor is usually multilocular, appearing as a collection of cysts, with a smooth, firm, glistening surface. If the wall is thick, the surface is white. If the wall is thin and translucent, the color of the fluid within can be seen shining through. The cut surface of the cyst wall shows numerous intramural cysts of varying sizes. Spurs and septa are frequently seen and represent the remains of adjacent cysts.

This is the most frequent ovarian neoplasm, comprising, according to the statistics of Pfannenstiel, 75 per cent of all ovarian tumors. It is unilateral in from 80 to 90 per cent of the cases.

These pseudomucinous cysts may grow to a very large size. Lynch gives an interesting compilation of "Mammoth Ovarian Tumors" in his monograph on *Pelvic Neoplasms*. In his review of the literature, he found 103 tumors weighing between 100 and 200 pounds, 9 between 200 and 300 and one, re-

ported by Spohn of Texas, weighing 328 pounds. No standard method of estimating the weight of these tumors has been followed. In the case reported by R. J. Crossen (Fig. 1004) the patient was weighed immediately before and after operation, which seems to be the most accurate of the reported methods of arriving at the weight of the tumor.
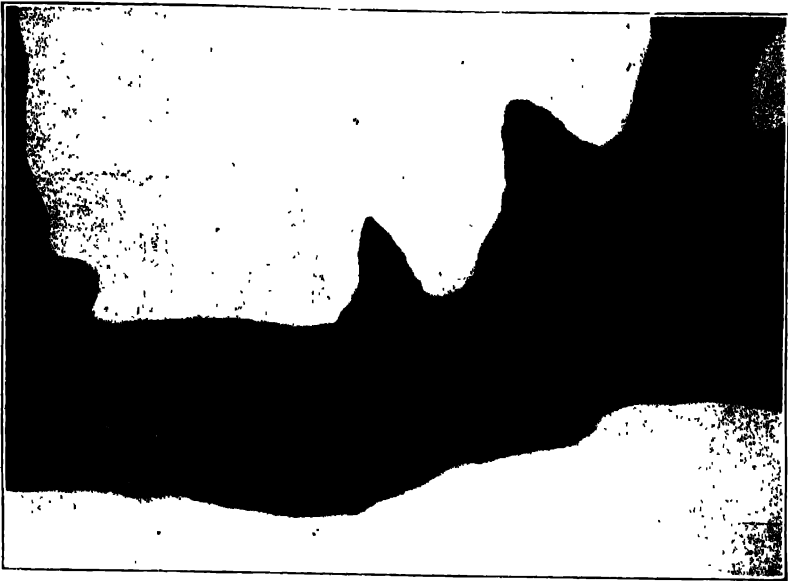
Fig. 1002.—Pseudomucinous cyst of ovary, high power, showing the typical cells lining a pseudomucinous cyst. Notice that the cells are very long, stain only lightly on account of the pseudomucin, and the nucleus is placed at the base. Gyn. Lab.
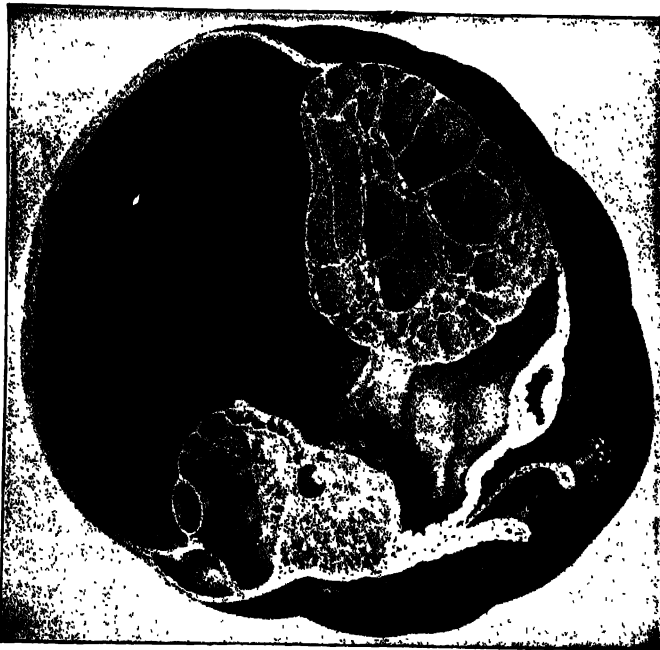
Fig. 1003.—A pseudomucinous cystadenoma of the ovary. Notice the development of secondary cysts in the wall of the large cyst. (Kelly—*Operative Gynecology.*)

Microscopic.—The walls of the cysts usually contain three layers—an outer fibrous layer, a middle layer of more cellular fibrous tissue, and an epithelial lining. The lining consists of high cylindrical cells containing a basal nucleus (Figs. 999 and 1002) similar to those lining the cervical canal but devoid of cilia. If there is marked intracystic pressure, these cells are flattened. The cells are in a single layer. Goblet cells are commonly found. Numerous small cysts are seen microscopically.

Implantation Recurrences.—These cysts are nonmalignant. Of course a complicating malignancy may develop in the cyst, but fortunately this is not common. Cures after complete removal of these cysts are close to 98 per cent.
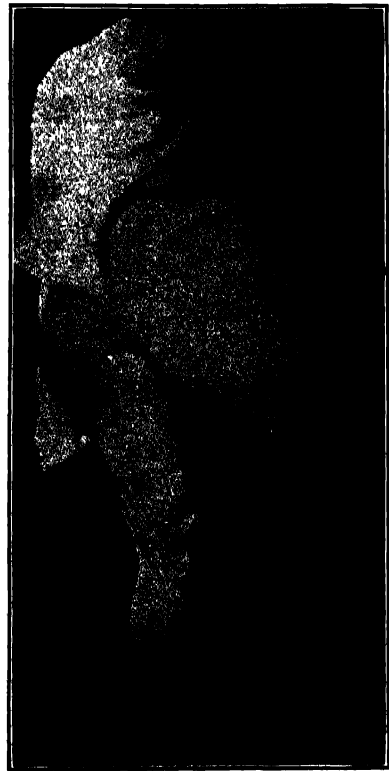
A.   *B.*

Fig. 1004.—Seventy-five-pound ovarian cyst. *A,* Front view of the patient. *B,* Side view of the patient. (R. J. Crossen and Soule—*Am. J. Obst. and Gynec.*)

Care should be taken, however, in removing these cysts not to allow the contents to spill into the peritoneal cavity, as implantation metastasis is apt to occur. If this does happen and the condition becomes progressive, the jelly-like substance is so thick that it clogs the peritoneal lymphatics. A foreign body peritonitis results, producing granulation tissue, giant cells, and connective tissue. This condition as designated "pseudomyxoma peritonei." Pseudomyxoma peritonei may start also from a pseudomucinous growth in some other structure; e.g., the appendix.

These cases must be operated on frequently, because this is the only way in which the material can be removed. Biggs reported removing 350 pounds

of this material in twelve operations over a period of nine years before death claimed the patient at seventy-five years of age. Death is usually due to mechanical interference in the abdominal cavity and adjacent tissues.

Etiology.—While the origin is not clear, it is possible that pseudomucinous cystadenomas arise from early cell-rests with intestinal-cell potentialities. Selma, in discussing ovarian tumors arising from embryonic rests states:

"Ribbert first advanced the theory that pseudomucinous cystadenomas are of teratomatous origin, with cells of intestinal anlage being the only ones to develop. This brings a very large group of tumors into the class of teratomas.
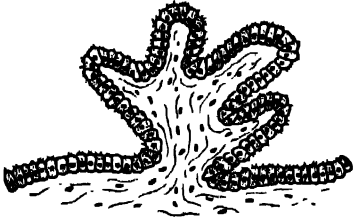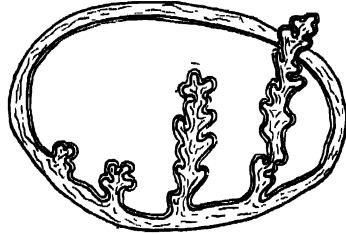
Fig. 1005.   Fig. 1006.

Fig. 1005.—High power field of papillary projection showing ciliated, cuboidal cells.
Fig. 1006.—On right, papillary projections in cyst. (Crossen and Crossen—*Synopsis of Gynecology*.)
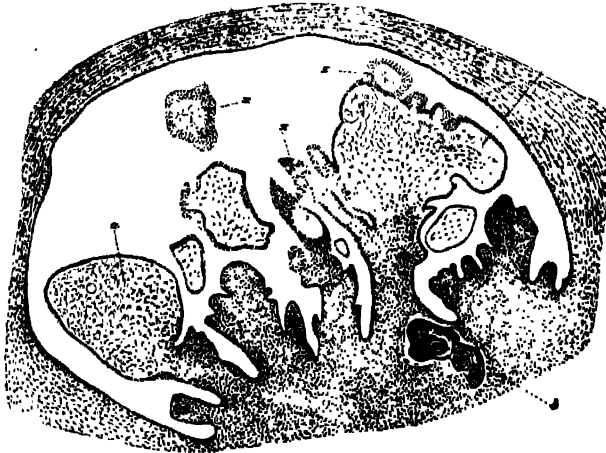
Fig. 1007.—A papillary cystadenoma of the ovary. The papillary projections within the cyst grow to the opposite wall and then penetrate it. (Pfannenstiel—*Veit's Handbuch*.)

In favor of his view is the fact that pseudomucinous cystadenomas have an epithelium strikingly similar to that of the intestine. Second, they occur frequently in association with the usual type of dermoid or teratoma. Third, the origin of pseudomucinous cystadenomas is not from the invaginations of the germinal epithelium, as has been shown for serous cystadenomas."

Additional items pointing in this direction are (a) that similar tumors occasionally originate from the intestine and (b) that similar cell growths are found at times in Brenner tumors. Proescher and Rosasco and also Novak discuss the relation of Walthard's cell islands to Brenner tumors and pseudomucinous cysts (see quotations under Brenner Tumors).

Serous Cystadenomas.—This form of tumor is known also as "papillary cyst" and as "cystadenoma invertens." The contents of the serous cyst par-

take of the nature of serum and do not present the gelatinous character of that of the pseudomucinous variety. On chemical examination, the contents show a large amount of albumin and no pseudomucin. The contents of the serous cysts, like those of the other variety, may vary much in color and consistency—this variation being due to the amount of hemorrhage into the cyst. The cells apparently have no secretion, and consequently there is no marked intracystic pressure as there is in the pseudomucinous cyst. On account of

Fig. 1008.—A papillary cystadenoma, sectioned and showing the papillary projections into the cyst cavity. (Penrose—*Diseases of Women*, W. B. Saunders Company.)
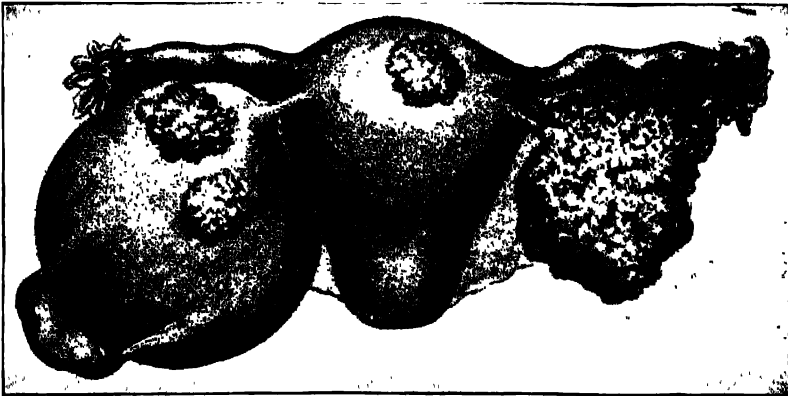
Fig. 1009.—Papillary cystadenoma of each ovary. On the left side the internal papillary projections have grown through the opposite wall and appear on the external surface. On the right side the papillary growths have obliterated all resemblance to a cyst, and appear simply as a cauliflower growth in the region of the ovary. Note the metastasis on the peritoneal surface of the uterus. (Penrose—*Diseases of Women.*)

this absence of internal pressure, the cells, as they proliferate, pile up, forming papillary projections into the interior of the cyst (Figs. 1005 to 1008); hence the name "invertens." These papillary masses (consisting of a layer of epithelial cells and some stroma), when they come in contact with the opposite wall of the cyst, penetrate the wall and appear outside as papillary growths on the external surface of the cyst (Fig. 1009).

Usually a few glandlike eversions may be found in the wall, but they are insignificant. Occasionally, however, a serous cystadenoma will present nearly altogether evertent growths (glandlike projections into the wall of the cyst)— serous cystadenoma evertens.

Etiology.—The serous cysts are usually bilateral. There are three theories as to their cause: (1) that they develop from the germinal or surface epithe-

Fig. 1010.

Fig. 1010.—Wall of a benign serous papillary cyst. These projections are covered with epithelial cells that have no tendency to invade. Gyn. Lab.

Fig. 1011.—Papillary cyst. Low power of lining, showing its papillary character. Gyn. Lab.

Fig. 1011.

Fig. 1012.—Papillary cyst. High power showing the character of the cells covering the papillary projections. Gyn. Lab.

lium of the ovary (including invagination, tubules, and small cortical cysts), (2) that they develop from graafian follicles, and (3) that they develop from the wolffian tubules. McCarty made a careful study of cases of serous cyst-adenoma in which both ovaries were removed. In many of these cases one ovary contained the cyst and the other appeared grossly normal. He found that 100 per cent of these grossly normal ovaries (removed prophylactically because of a serous cyst of the other ovary) contained small cortical cystic structures, while only 60 per cent of a normal control group contained them. Two of the prophylactically removed ovaries showed beginning tumors arising from small epithelial cystic structures in the cortex, one an early carcinoma and the other a beginning papillary cyst. He concludes from his study (a) that most papillary ovarian cysts develop from the small germinal epithelial cystic structures found in the cortex of the normal ovary, and (b) that the grossly normal ovary associated with a papillary cyst of the other ovary is a potential danger and should be removed if the age of the patient permits.

Microscopic.—The cells lining the serous cyst are uniform in size and one layer thick. They are low cylindrical, with a centrally placed nucleus and a granular cytoplasm (Figs. 1000 and 1005), and the papillary masses present the pictures shown in Figs. 1010 to 1012.

Malignancy.—These serous cysts have a greater tendency to develop malignant complications than do the pseudomucinous variety, and because of their tendency to be bilateral both ovaries should be removed except in young patients. The percentage of cures is distinctly lower than with pseudomucinous cysts.

The characteristics of the pseudomucinous and serous cysts may be presented and contrasted concisely as follows:

PSEUDOMUCINOUS CYST	SEROUS CYST
1. Contents gelatinous and secreted by the cells lining the cyst—may be any color.	1. Contents serumlike and not secreted by the cells lining the cyst—may be any color.
2. Secondary growths consist of glandlike projections outward (evertent) from the cavity into the wall, forming small cystic cavities in the wall.	2. Secondary growths consist of papillary projections inward (invertent) from the wall into the cavity, forming papillary masses which extend across the cavity and penetrate the opposite wall.
3. Lining cells contain pseudomucin, are columnar, with some goblet cells, and are not ciliated.	3. Lining cells contain no pseudomucin, are plain columnar, without goblet cells, and are ciliated.
4. Usually unilateral.	4. Usually bilateral.
5. Rarely ruptures spontaneously.	5. Usually ruptures at any early stage, because of perforation of the wall by the the papillary ingrowths.
6. Rarely causes peritoneal metastases.	6. Usually causes peritoneal metastases, consisting of widespread papillary growths.
7. Rarely undergoes malignant change.	7. Frequently undergoes malignant change.
8. Very common.	8. Not so common.
9. Cause unknown. See theory under Etiology.	9. Cause unknown. See theories under Etiology.

Clinical Manifestations

Taking up the clinical manifestations of the proliferating cysts (both pseudomucinous and serous), it is found that they may **occur** at any age, but are most frequent during the period of greatest ovarian activity, i.e., between the twentieth and fiftieth years.

In shape, a proliferating cyst may be spherical and regular in outline, indicating a single large cyst, or it may be irregular, presenting nodules indicating a multilocular cyst. In size these cysts vary from a small tumor the size of an egg to a large tumor filling the whole abdomen.

As to appearance when exposed by abdominal incisions, the wall of the cyst presents a white, glistening appearance. The thinner portions are straw-colored or green or black, according to their fluid contents. The surface of the cyst may be perfectly smooth, or may be covered by a papillary growth, or may be bound to adjacent structures by adhesions. The tumor usually has a distinct pedicle.

The cyst wall consists of three layers—an outer and inner firm fibrous layer, with a middle layer of looser tissue between them. In the middle layer of loose connective tissue the vascular supply is distributed.

The contents of cysts present marked contrast in consistency and in color. The contents may be thin like water (serous cysts), or thick and viscid and of gelatinous consistency (pseudomucinous cyst). The contents may be almost colorless or straw-colored or a dirty yellow, or green or black. The color depends on hemorrhage into the cyst. The coloring matter of the blood becomes the coloring matter of the cyst contents.

As these cysts enlarge they bear various relations to adjacent structures. If they rise out of the pelvis and enlarge in the abdomen, they may attain a very large size before producing serious symptoms. There they have plenty of room and expand freely, pushing aside the surrounding organs. If they become caught under the pelvic brim and develop in the pelvis, they soon begin to cause pain and other disturbances from pressure and distortion of the organs.

When the papillomatous growths within a cyst pierce the cyst wall (which happens most frequently in the serous cyst), peritoneal implantations may occur. In some cases these peritoneal implantations grow rapidly and fill the pelvis with papillary masses. In such a case the first impression, when the abdomen is opened, is that the pelvis is filled with a cancerous mass, which cannot be removed and which will soon cause death. Accordingly, in not a few cases, the operator, after scraping out some of the papillary bleeding growth, has closed the abdomen and told the patient or her friends that there was an inoperable cancer and that she could not long survive. Some such patients get entirely well after the operation. In other cases malignant change has already begun or begins later and the patient dies of carcinoma. In still other cases the growth itself becomes so extensive as to interfere with the functions of adjacent organs and thus causes death.

Symptoms and Diagnosis

An ovarian cyst usually develops slowly and may attain considerable size before it is discovered. Often it is noticed then only by accident.

The earliest symptoms are a feeling of weight and pressure in the pelvis, bladder irritability, slight menstrual disturbance, constipation, and perhaps some pain with bowel movement. The symptoms are not distinctive, but simply indicate some disturbing factor in the pelvis. As the tumor increases in size, distinct pressure symptoms appear and the general nutrition becomes affected.

There is enlargement of the abdomen, swelling of the feet from pressure on veins, pain from pressure on nerves, and dyspnea from pressure on the diaphragm. There appear, also, stomach disturbances, emaciation, and progressive weakness. In some cases there are attacks of local peritonitis, with severe abdominal pain and some fever, but these inflammatory symptoms are due to complications and do not belong to the natural history of the tumor.

Ovarian cysts grow slowly, usually taking several years to reach a large size. But they seldom stop growing. They persistently enlarge until the patient finally dies from exhaustion brought about by pressure effects on vital organs.
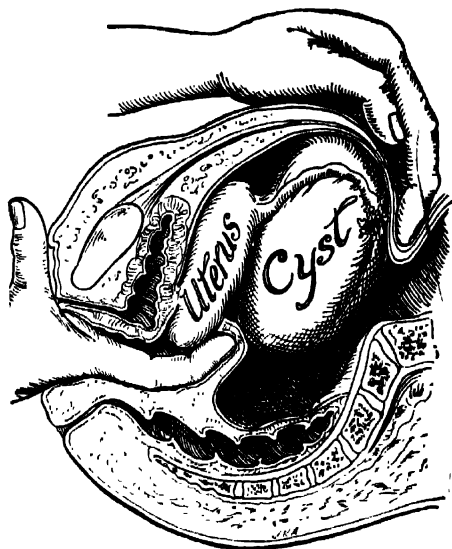
Fig. 1013.   Fig. 1014.

Fig. 1013.—An ovarian cyst lying back of the uterus. (Ashton—*Practice of Gynecology*, W. B. Saunders Co.)

Fig. 1014.—Showing the method of testing the mobility of such a mass. (Ashton—*Practice of Gynecology.*)

The diagnosis in typical cases is easy, but in complicated cases it may be very difficult, and in exceptional cases a positive exact diagnosis is impossible before operation. Tapping the cyst through the abdominal wall as an exploratory measure is not advisable. An adherent coil of intestine may be punctured, or cyst contents may leak into the peritoneal cavity and cause fatal peritonitis. In a doubtful case, an exploratory abdominal section is safer and far more satisfactory in diagnostic results.

In taking up the differential diagnosis of ovarian cysts in general, it is at once apparent that the symptoms and diagnostic points are different in the different sized tumors.

Small Ovarian Cyst.—Considering the small ovarian cyst according to the seven principal diagnostic points in the palpation of pelvic masses (position, size, shape, consistency, tenderness, mobility, attachment—see Bimanual Examination of Corpus Uteri and Other Pelvic Masses, Chapter II, it is found that an ovarian cyst of this size presents the following characteristics:

1. Is situated in the lateral part of the pelvis, though in exceptional cases it may drop down directly behind the uterus or in front of it.

2. The small ovarian cyst is the size now under consideration—about as large as the fist or a little larger.

3. Is approximately spherical, though may be made uneven by secondary cysts.

4. Contains fluid (fluctuates).
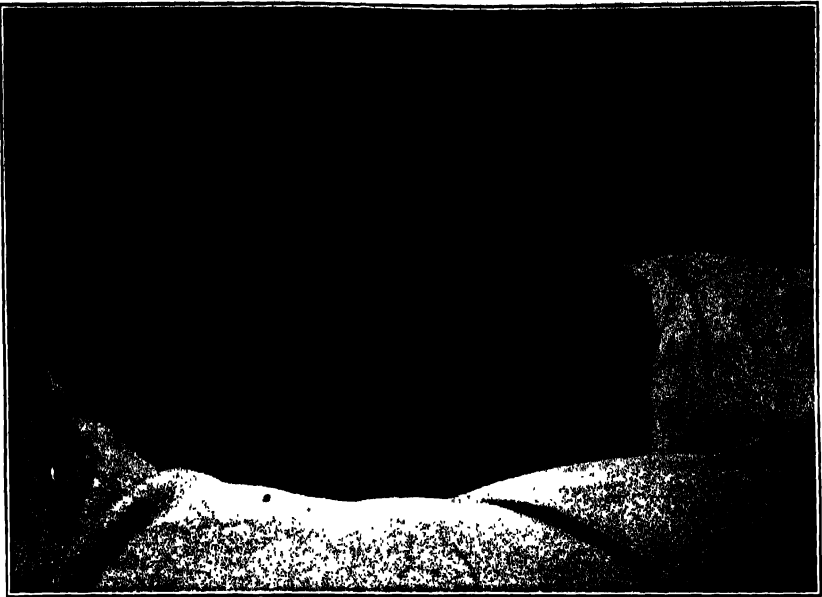
Fig. 1015.—Patient with a large ovarian tumor.
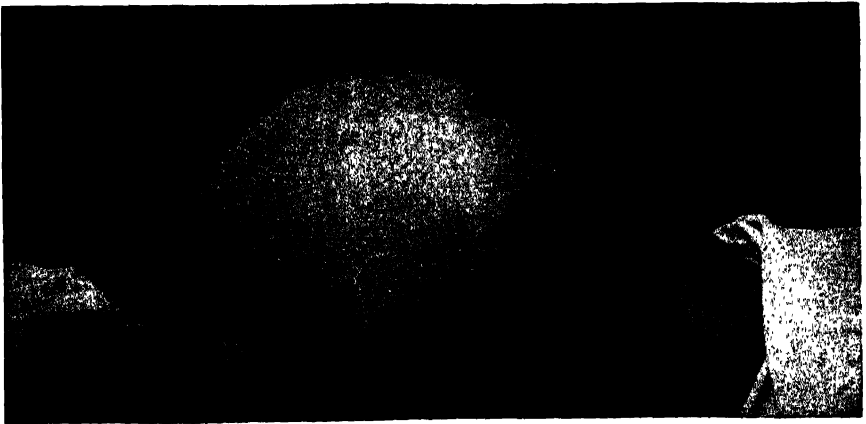
Fig. 1016.—Extreme ascites. In the patient of whom this photograph was taken, the abdomen was so distended with fluid that the wall was raised higher than the mesentery would permit the intestine to float, giving dullness about the umbilicus as well as elsewhere. The rise of the wall from below is rather abrupt. There is also edema of the wall, as shown by the persisting groove where the skirts were fastened about the waist.

5. Is not tender, unless complicated by inflammation or by torsion of pedicle.

6. Is freely movable (Figs. 1013, 1014), unless complicated by adhesions or caught under the sacral promontory.

7. Is attached in the lateral part of the pelvis. Apparently arises from the tubo-ovarian region. Lies beside the uterus, but is not attached to it and does not ordinarily modify it in any way, except to cause some displacement toward the opposite side.

If the cyst is uncomplicated, there is no history of pelvic inflammatory attacks—that is, the mass has progressed to its present size independent of inflammation or hemorrhage, which identifies it at once as a new growth.

The following conditions may be confounded with a small ovarian cyst and must therefore be taken into consideration in the **differential diagnosis:**

> a. Salpingitis with exudate.
> b. Pyosalpinx.
> c. Hydrosalpinx.
> d. Tubal Pregnancy.
> e. Fibroid Tumor of the Uterus.
> f. Retroverted Pregnant Uterus.
> g. Broad Ligament Cyst.

Large Ovarian Cyst.—A growth large enough to cause the abdomen to be prominent (Fig. 1015) must be differentiated from the following conditions:

> a. Tympanites and ''Phantom Tumor.''
> b. Obesity.
> c. General Ascites (Fig. 1016).
> d. Pregnancy (normal, with hydramnios, extrauterine).
> e. Cystic Fibroid of Uterus.
> f. Distended Bladder.
> g. Tumor of some Abdominal Organ.
> h. Tuberculous Peritonitis.

Complications

Having determined that an ovarian cyst is present, we must then consider certain complications that may be present or that may appear later. These complications are as follows:

> 1. Local peritonitis, forming adhesions.
> 2. Hemorrhage into the cyst.
> 3. Rotation of the cyst, producing torsion of the pedicle.
> 4. Inflammation and suppuration of the cyst.
> 5. Rupture of the cyst.
> 6. Ascites accompanying the tumor.
> 7. Intestinal obstruction.
> 8. Pregnancy accompanying the cyst.

1. **Local Peritonitis** is accompanied by some pain and tenderness over a part of the tumor. There may be some fever, but usually this symptom is not marked; the process consists simply of irritation at some portion of the outer surface of the cyst and the formation there of plastic exudate, binding the cyst to some adjacent organ or to the abdominal wall. In a few days the pains disappear, but the exudate remains, becomes organized, and forms an adhesion, which may interfere more or less with the subsequent operation.

2. **Hemorrhage into the Cyst** is what gives the various colors to the cyst contents. This hemorrhage usually takes place slowly in small quantities and without clinical symptoms. Occasionally, however, a copious hemorrhage takes place, usually from some interference with the venous return, such as twisting of the pedicle or pressure of an enlarged uterus, or it may follow tapping of the cyst. The hemorrhage may be so severe as to cause collapse of the patient.

3. **Rotation of the Cyst** may take place where the pedicle is long (Figs. 1017, 1018). The amount of rotation varies from a half turn to several complete turns. Torsion of the pedicle is supposed to be favored by an injury, such as a fall or blow, and by active exercise, and also by the alternate filling and emptying of the bladder and the bowel, and during pregnancy by the enlargement of the uterus.
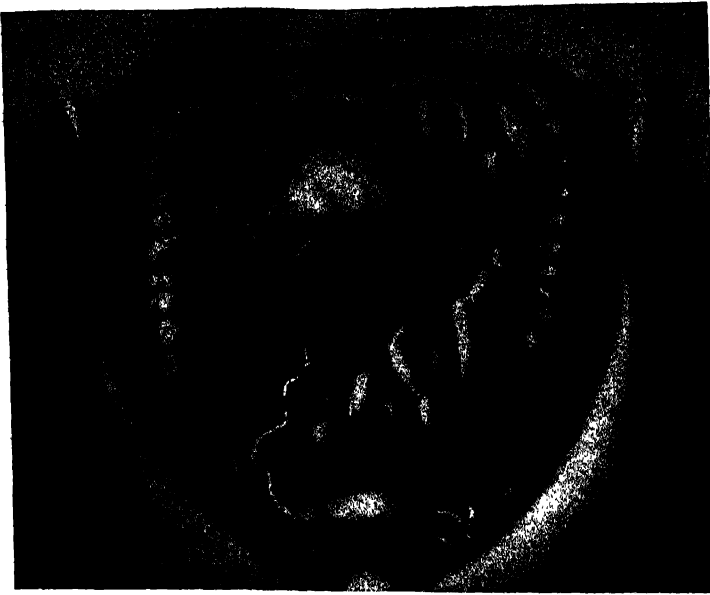
Fig. 1017.—Ovarian cyst with a long slender pedicle. (Montgomery—*Practical Gynecology.*)
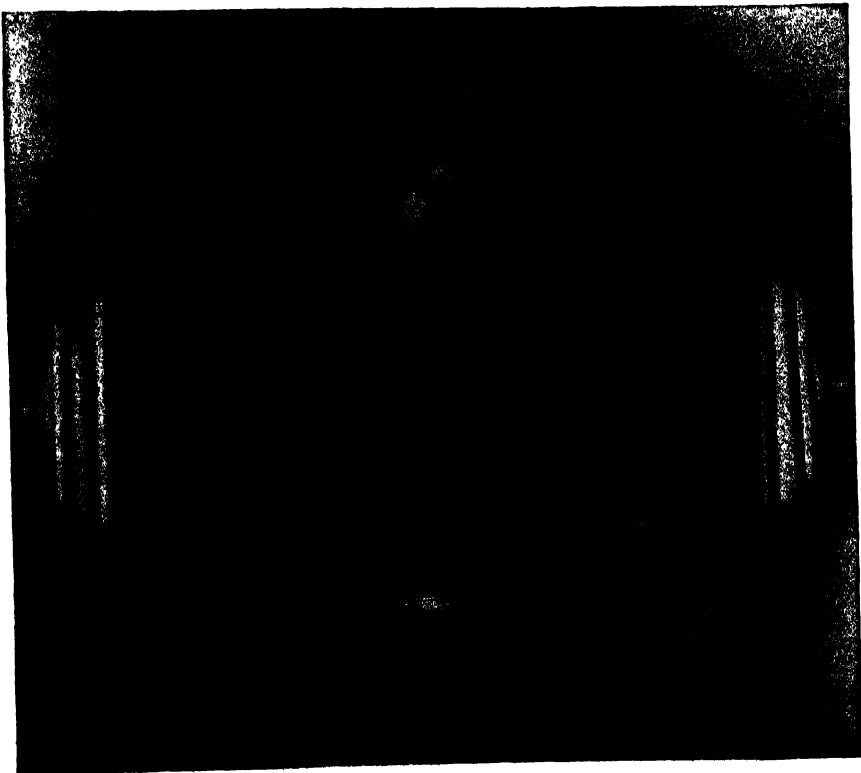
1018.—Indicating an ovarian cyst with twisted pedicle. The turning of the tumor pedicle, blocking the circulation and causing thrombosis in the pedicle and throughout extravasation of blood causes the affected tissues to become black.

The effect of torsion of the pedicle on the circulation of the tumor depends, of course, on the amount of rotation. The veins are the first to suffer. The flow of blood in them is impeded, causing the tumor to become engorged, and there is hemorrhage into the interior of the cyst, either in the form of extravasation or the rupture of a vein with severe hemorrhage. If the twisting increases, there is thrombosis of the vessels (Figs. 1019, 1020) and extravasation of bloody fluid into the peritoneal cavity, and later necrosis of the tumor, followed by fatal peritonitis. The symptoms of torsion of the pedicle are very marked. When a patient with an ovarian tumor complains of sudden pain in the abdomen and vomits, and there is a sudden increase in the size of the tumor, it is probable that torsion of the pedicle has taken place. In some cases there are repeated attacks of slight torsion.

4. **Inflammation and Suppuration of the Cyst** are, of course, due to infection. The infection may come from the intestinal canal or from the bladder or from a fallopian tube or from tapping the cyst. The most common source of infection is the fallopian tube. The patient contracts salpingitis, adhesions form between the inflamed tube and the cyst wall, and infection spreads along these adhesions, and invades the cyst. Adhesions with some portions of the intestinal tract, especially with the appendix, may likewise lead to infection of the cyst. Tapping, which was formerly a common procedure, often led to infection of the cyst. Dermoid cysts are especially prone to suppuration. Infections of cysts are not uncommonly seen in the course of the acute infectious fevers, especially typhoid.

The symptoms of suppuration of the cyst are pain, fever, tenderness over the tumor, rapid pulse, exhaustion, and emaciation. If the suppurating cyst does not speedily cause death by peritonitis, it may later rupture into the intestine or bladder or vagina. The teeth, hair and pieces of bone discharged in rare cases from the urethra or rectum are usually due to suppuration of a dermoid cyst.

5. **Rupture of the Cyst** may be sudden, as from a fall or blow or other injury, or it may be the result of a gradual thinning of the cyst wall. The result of rupture of the cyst depends on the quantity and quality of the cyst contents. In unilocular cysts with non-irritating fluid, rupture may produce no severe symptoms. There are some weakness and abdominal pain and marked diuresis, the patient sometimes passing several gallons of urine in twenty-four hours. The abdomen, which was prominent from the tumor, becomes flattened and lax. The physical signs change from those of encysted fluid to those of free fluid. The cyst may not refill, and if no inflammation takes place, the patient recovers. But this favorable termination takes place only in rare cases. In the great majority of cases of cysts, rupture causes peritonitis, which may be very severe and rapidly fatal.

Rupture of a cyst is indicated by the sudden disappearance of the tumor or marked diminution in its size, accompanied by evidences of free fluid in the peritoneal cavity and collapse of the patient, and later peritonitis and death.

6. **Ascites.**—A small amount of ascitic fluid may be present with many cysts, but a large quantity is rare so long as the tumor retains its normal condition. Consequently, the presence of considerable ascitic fluid with an ovarian cyst becomes of diagnostic importance. The ascites may, of course, be due to some heart trouble or kidney trouble or liver trouble, or may be due to peritoneal tuberculosis. Aside from such complications, ascitic fluid is indicative of some serious complications; e.g., a papillary cyst, especially after malignant change, or rupture of an ordinary cyst.

7. **Intestinal Obstruction.**—This may be caused by direct pressure of the tumor or by adhesions which contract and narrow the intestine. It is, of course, a very serious complication and is indicated by the ordinary symptoms of intestinal obstruction appearing in the presence of an ovarian tumor.

8. **Pregnancy** may accompany an ovarian cyst, adding much to the difficulties of diagnosis.

Treatment

The treatment of the **proliferating cysts** is removal by operation as soon as found, if the condition of the patient will permit.

These ovarian tumors are not at all influenced by palliative measures, they do not stop growing spontaneously, and they tend to cause death within
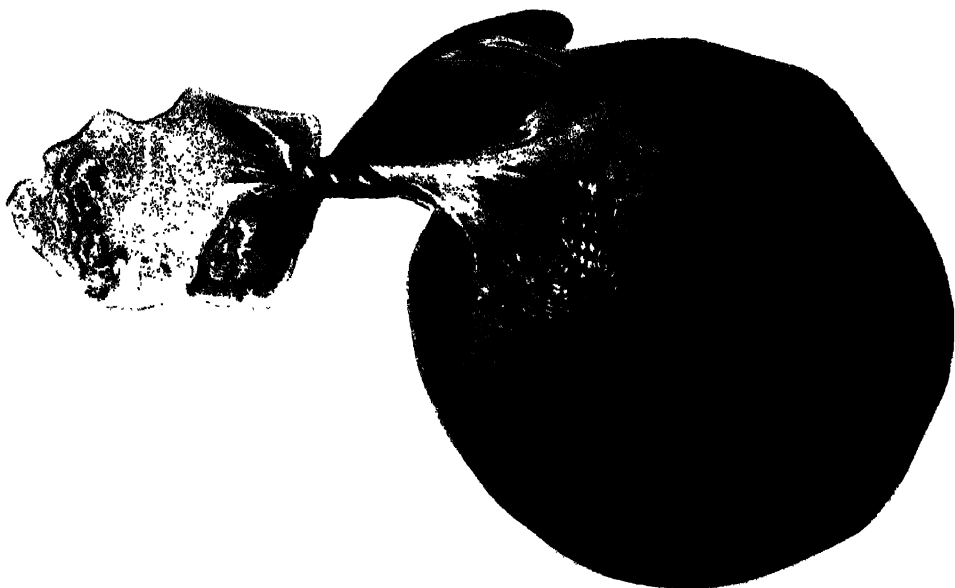
Fig. 1019.—Dermoid Cyst of Ovary with Torsion of Pedicle Causing Thrombosis. At operation the tumor was so large and adherent that extension of the incision above the umbilicus was necessary for its removal. The twist in the pedicle, which included also the fallopian tube, showed two complete turns. It was necessary to remove the corpus uteri along with the tumor, and the uterus is shown opened. Color drawing from fresh specimen. (Crossen and Crossen—*Operative Gynecology.*)
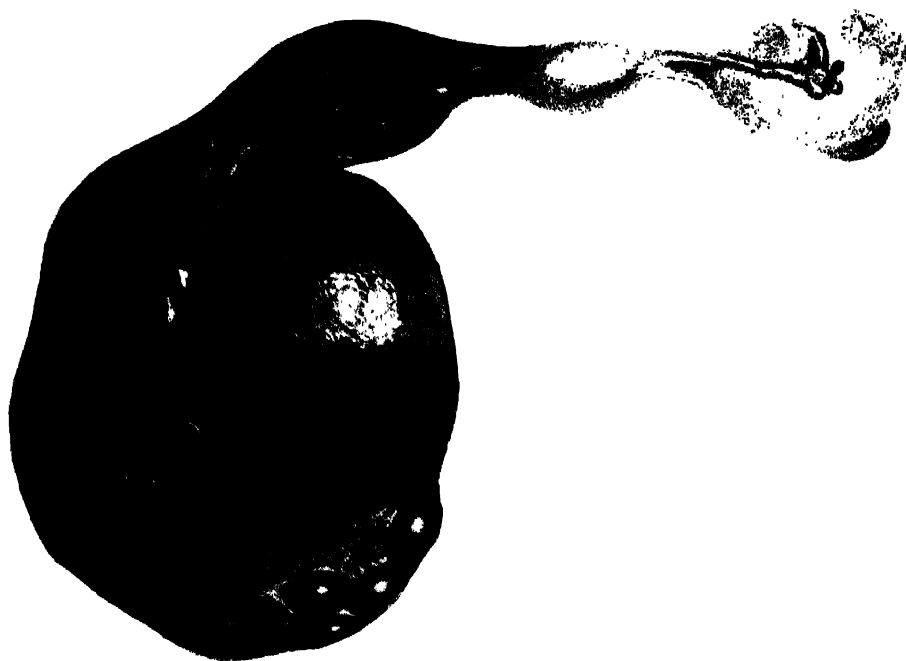
Fig. 1020.—Double Ovarian Cyst with Torsion of Pedicle Causing Thrombosis. At operation the left tumor appeared as a black mass, due to extensive hemorrhage into it. The tumor of the other ovary showed no torsion and no circulatory disturbance. It was necessary to remove the corpus uteri along with the tumors. The twisted area has been untwisted. Notice at the edge of the uterus the clear-cut margin of the thrombosed area. The rounded swelling between the uterus and the tumor is due to a hemorrhage into the tissues just beyond the twist. Color drawing from fresh specimen. (Crossen and Crossen—*Operative Gynecology.*)

a few years. Consequently they should be removed as soon as found or as soon as the patient can be put in condition for the operation. Sometimes the patient is in such a weakened condition that she must be given a course of treatment before operation. Some general disease, such as kidney, heart or lung trouble, may make it necessary to delay the operation until the patient can be put in better condition.

Then, again, the patient may be in such condition that a radical operation would be almost certainly fatal. In such a case it would, of course, be useless to operate. In some such inoperable cases the patient may be rendered temporarily more comfortable by tapping the cyst with a trocar and drawing off the fluid. In all cases of proliferating cysts, however, in which the patient is in suitable condition, the tumor should be removed by operation.

SIMPLE SOLID TUMORS

Simple solid tumors of the ovary are infrequent and usually small. Fibroma is the principal one, though myoma or adenomyoma may occur.

Fibroma of the Ovary

Ovarian fibromas are rare tumors comprising about 2.5 per cent of all ovarian tumors. Little is known about etiology of fibromas. They have been found at ages ranging from ten to eighty. They are bilateral in about 20 per cent of the cases, and ascites is almost always present if the tumor is at all large.

Fig. 1021.—A small ovarian fibroma. Cross-section, showing the typical fibromatous structure and a well-defined capsule. Gyn. Lab.

These may occur as small circumscribed tumors of white pearly appearance embedded in the stroma or on the surface of the ovary, or they may be diffuse, involving the entire ovary. Clemens reported a large one weighing 40 kg. On cutting into the tumor, it is usually found to be cartilaginous or of bony hardness, but it may be soft if edema or necrosis is present. Occasionally one finds areas of calcification and even ossification.

Four cases of ovarian fibroma with associated ascites and hydrothorax were reported by J. V. Meigs in 1937. Others later reported several cases of this "Meigs' syndrome," and a 1943 article by Meigs, Armstrong and Hamilton brought to 27 the reported cases of ovarian fibroma with this striking complication, which is remarkable because of the comparative rarity of ovarian fibroma.

The treatment is removal of the growth, and thorough microscopic investigation of it. Carcinoma of the ovary is so insidious and symptomless in the earlier stages that any ovarian mass must be held under suspicion, particularly if solid and in a patient of cancer age.

MISCELLANEOUS RARE TUMORS

A *lymphangioma* was reported by Siddall and Clinton, a *ganglioneuroma* by Schmeisser and Anderson and a *mesonephroma* by Jones and Seegar. The latter state:

> In reviewing over 350 true neoplasms of the ovary, a group of 6 has been separated on the basis of their pathologic characteristics. Schiller has recently described a similar group of cases and believes them to be derived from mesonephric tissue. It is the purpose of this paper to describe the clinical and pathologic characteristics of these tumors and to discuss their histogenesis. These tumors occurred after the age of forty and presented no characteristic clinical features. Four were found to be benign and two malignant.

The ovary is the source of so many different kinds of tumors that every specimen should be submitted to microscopic check-up, and every atypical specimen should be carefully studied as to exact type and probable origin. When we can substitute demonstrated facts for the present interesting but uncertain theories, we shall have attained the long-sought goal of a comprehensive satisfactory classification of ovarian tumors. To assist in this direction a responsible American Registry of Ovarian Tumors has been established, for special study of specimens and slides sent to it, as explained by Novak (see Additional References).

CANCER OF THE OVARY

In the ovary as elsewhere malignant disease appears in the two common forms—carcinoma and sarcoma. We have already considered various special ovarian tumors in which definite malignancy was manifested in some cases of certain types. Here the common forms of cancer are considered.

Pathology

Of the two forms, carcinoma and sarcoma, carcinoma is by far the more frequent.

Carcinoma.—This form of malignant disease may be primary in the ovary or may be secondary to a growth in some other structure.

Primary.—Carcinoma developing with the ovary as the primary focus is found in from 10 to 12 per cent of ovarian neoplasms. Those arising in papillary cystadenoma form by far the largest group, with pseudomucinous cysts and dermoids accounting for from 3 to 5 per cent. In a series reported by Pfannenstiel, the carcinoma was bilateral in 90.9 per cent. The highest incidence occurred between the ages of forty-five and fifty-five, but they have been found in young children and elderly women. There is an accompanying ascites in 78 per cent of the cases.

The gross appearance varies with the type of carcinoma. In the slower growing type, secondary to a cyst, the surface of the cyst is usually studded with papillae. On opening the cyst the cavity is found to be filled with a granular cauliflower-like material. If proliferation is very rapid, the tumor

may be solid, but they are usually soft. On opening this type of tumor the inner pulp pouts out through the rent in the wall. In some specimens the solid areas resemble soft white brain tissue.

The microscopic examination of this tissue shows glandlike areas in the slower growing tumors (Fig. 1022), while in the more rapidly growing tumors there are solid interlacing cords of cells with no attempt at gland formation.
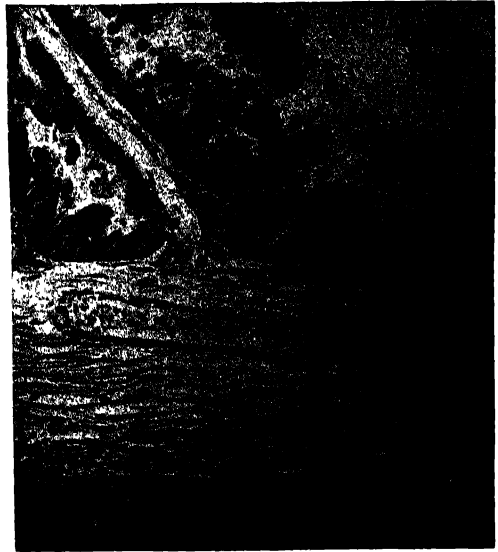
A.   B.

Fig. 1022.—Malignant papillary cyst. A, High power, showing the piling up of the epithelial cells and other characteristics of malignancy. B, Still higher power of the left central area in A, showing the individual cell characteristics. (Erdmann and Spaulding—Surg., Gynec. and Obst.)
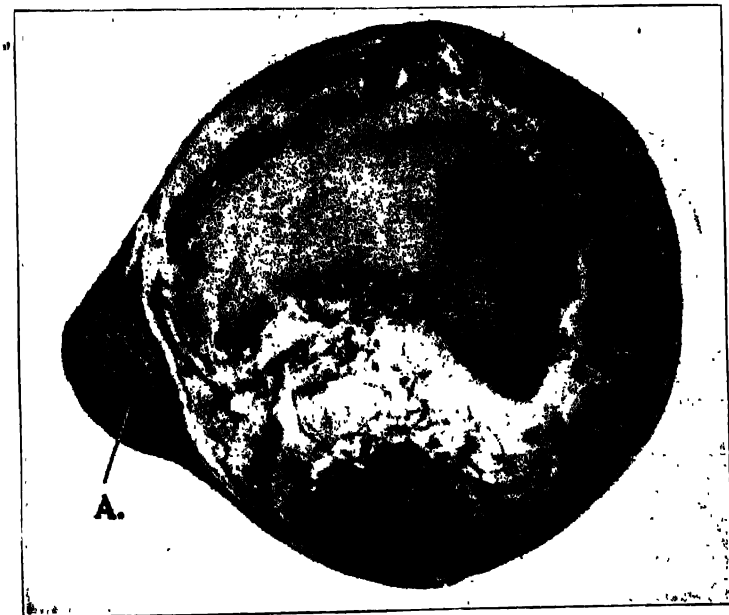
A.

Fig. 1023.—A dermoid cyst of the ovary showing beginning carcinoma at A. (Spalding—Am. J. Obst.)

Occasionally one can trace the epithelium in the glandlike structures from a single layered benign epithelium to a frankly malignant multilayered polymorphus atypical epithelium.

Occasionally a carcinoma develops in a dermoid, and is usually of the squamous-cell variety arising from the epidermis in the dermoid. Fig. 1023 shows such a growth. Solid primary carcinomas of the ovary are rare.

Some are of the medullary type. They are of soft consistency as the result of degenerative processes, which are clearly shown on cross-section.

Fig. 1024.   Fig. 1025.

Fig. 1024.—Ovarian carcinoma, Grade 1. There is good glandular formation, with well-differentiated columnar epithelium. The mature type of structure is maintained throughout, except in occasional areas where early malignant changes are seen, such as the epithelial cells piling up in numerous layers in the glands or penetrating the stroma. This is the least malignant type. (Montgomery and Farrell—*Am. J. Obst. and Gynec.*)

Fig. 1025.—Ovarian carcinoma, Grade II. Glandular and papillary structures are still present, but they are poorly developed. The columnar epithelium is not so well differentiated. There are moderate variations in the size and shape of the cells, nuclear changes, and more extensive infiltration. In this type the malignancy has increased very decidedly. (Montgomery and Farrell—*Am. J. Obst. and Gynec.*)
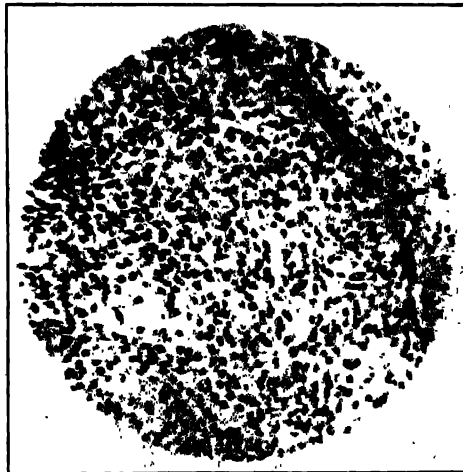
Fig. 1026.—Ovarian carcinoma, Grade III. There is little evidence of glandular or papillary structure, the fields showing practically solid carcinoma. There are marked nuclear changes and undifferentiated epithelial cells. This is the most malignant type. (Montgomery and Farrell—*Am. J. Obst. and Gynec.*)

Local metastases are the rule, especially to the surrounding organs and the peritoneum. The lymph glands commonly involved are the inguinal and lumbar and supraclavicular.

Pathologic Grading.—Various groupings have been proposed with a view to definite pathologic classification of ovarian carcinomas, to aid in accurate recording and reporting of cases so as to permit analysis and comparison, as to prognosis in the different classes and as to results of various kinds of treatment. The following classification, suggested by Taylor, seems a practical and

Fig. 1027. Fig. 1028.

Fig. 1027.—Krukenberg tumor of ovary.
Fig. 1028.—Same specimen shown in section. Gyn. Lab.

satisfactory one. It was used by Montgomery and Farrell in classifying their cases for clinical discussion, and the microphotographs showing a typical slide for each of the three grades are from their report.

Fig. 1024 shows Grade I, which has well-marked glandular character, and represents the lowest grade of malignancy. Fig. 1025 shows Grade II, which has only imperfect gland formation, and represents increased malignancy. Fig. 1026 shows Grade III, which has no gland formation, and represents the highest grade of malignancy.
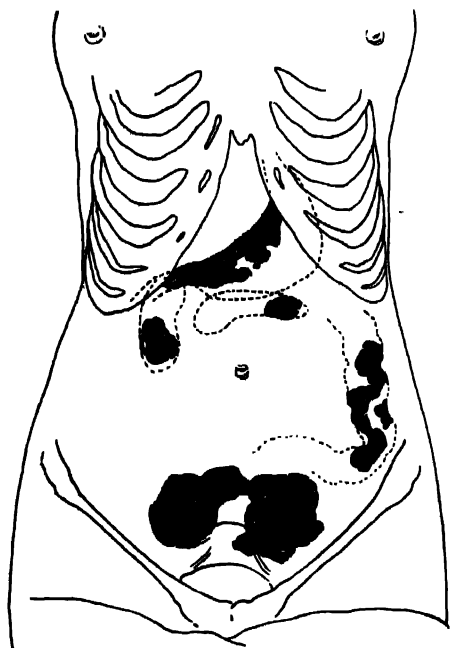
Fig. 1029.

Fig. 1030.

Fig. 1029.—Krukenberg tumor, indicating the primary growth (in the stomach) and the distribution of the secondary growths in this case (both ovaries, right kidney, pancreas, and sigmoid flexure of the colon).

Fig. 1030.—Krukenberg tumor of ovary. Microscopic section, low power. Gyn. Lab.
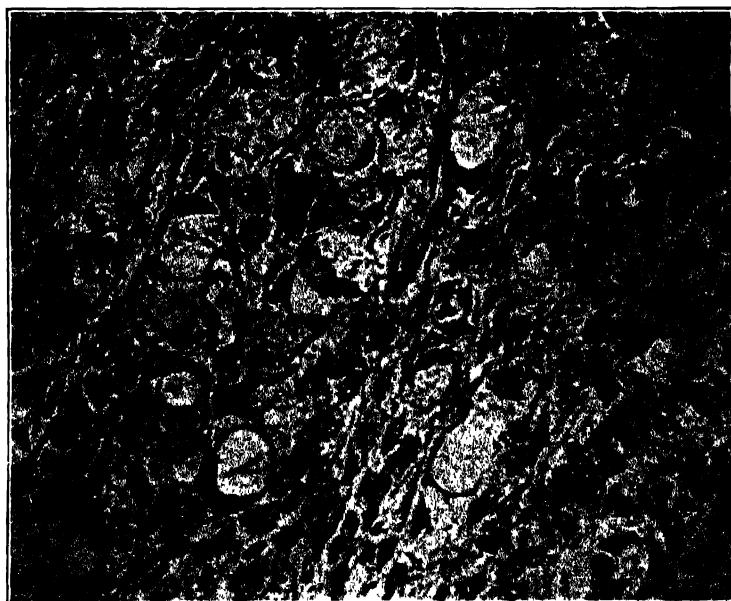
Fig. 1031.—Krukenberg tumor of ovary. High power of specimen shown in Fig. 1030. The characteristic "sickle" or "signet ring" cells are well shown. Gyn. Lab.

For the reasons above mentioned, every specimen of ovarian carcinoma sent to the laboratory should have this grading recorded, and the classification in this respect should be included in the report to the physician.

Secondary.—Metastatic carcinoma of the ovary is not uncommon. In a series of 79 ovarian carcinomas secondary to primary tumors in the abdominal cavity reported by Schlagenhaufer, 61 were of gastric origin, 10 intestinal, 7 gallbladder and 1 probably pancreatic. Handley in 442 autopsies on patients dying of mammary cancer found metastases to the ovaries in 13.4 per cent.

In the early stages the metastases appear as small circumscribed nodules on the surface or in the substance of the ovary. The lesions are usually bilateral and subsequent growth of these ovarian tumors is very rapid. Early death of the patient usually prevents the tumors from becoming very large, though some large ones have occurred.

The most typical of the metastatic ovarian growths is the Krukenberg tumor, which is secondary to a certain type of gastric and intestinal carcinoma. These tumors are fairly large, as a rule, are smooth, and have a glistening white surface. They are usually solid and are hence easily mistaken for sarcoma. The gross and microscopic characteristics of such a tumor are shown in Figs. 1027 to 1031.

The microscopic examination of the Krukenberg tumor shows an edematous connective tissue of spindle cells, of various sizes, shapes, and staining qualities, interspersed with areas of necrosis and myxomatous degeneration. The cells which are characteristic of this tumor, however, are the large mucus-producing epithelial cells. These cells may be scattered through the connective tissue stroma or they may form alveoli. In the cells that are filled with the mucin the nucleus is pressed against the cell wall forming a crescent (Fig. 1031). The names of "seal ring," "signet ring," or "sickle" cells have been applied to these cells, and their presence aids in the diagnosis of the Krukenberg type of tumor.

The other types of metastatic tumors reproduce cells similar to those of the primary carcinoma, as do also the growths reaching the ovary by direct extension.

It is probable that other secondary carcinomatous growths are started in the ovaries by particles which have become detached from the primary carcinoma and through peristalsis and gravity have been carried to the ovaries deep down in the pelvis. It is this fact which most plausibly explains the common bilaterality of the solid ovarian cancers, a point of great practical importance and well justifying the demand of certain writers always to remove both ovaries even if only one macroscopically seems affected by a malignant growth.

For this same reason it becomes imperative in all cases of diagnosed or suspected bilateral ovarian carcinoma to search most carefully for a possible primary carcinoma in the gastrointestinal tract or in another organ within the abdominal cavity. It is obvious that in these cases operative efforts of necessity must prove futile.

Sarcoma.—Sarcoma of the ovary may be of the spindle-cell or round-cell variety and may be primary or secondary.

Primary.—Between 2 and 5 per cent of ovarian growths are primary sarcomas. One has been reported by Doran in a seven months' fetus, and this is the one type of tumor which is more common in young people. Pfannenstiel states that 40 per cent of the patients are under twenty-five years of age and Hubert collected 200 cases in children. Frank states that in his series they were most frequent between the ages of eighteen and twenty-five years. Bloody ascites is almost always present.

These malignant tumors are usually secondary to a fibroma of the ovary.

The gross appearance and the consistency of these tumors depend upon the degree of maturity of the constituent cells and on the amount of fibrous tissue present. The soft friable tumors are the round-cell tumors while the spindle cell variety is firmer and whiter in color. These tumors are usually bilateral and are shaped like a large kidney, due to the fact that the hilus
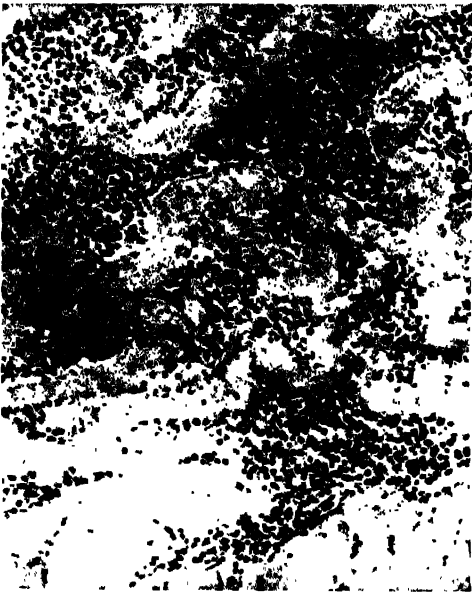
Fig. 1032.

Fig. 1033.

Fig. 1032.—Sarcoma of the ovary secondary to a sarcoma, originating in a uterine myoma. The sarcomatous infiltration has involved old remnants of a corpus luteum. Gyn. Lab.

Fig. 1033.—Mitotic figure in sarcoma cell. (Caylor and Masson—*Am. J. Obst. and Gynec.*)

remains retracted while the rest of the ovary enlarges. Tumors of the round cell type are so friable that they frequently fall apart when being removed at operation. The surface is usually irregular but fairly smooth, and there are necrotic areas present. On cut surface, one sees cystic cavities from necrosis or hemorrhage.

Frank divides the microscopic types into those in which unripe cells predominate and those in which the ripe cells make up the larger part of the tumor. The unripe types approach most nearly the embryonal types, and these include the round cell, the polymorphous and giant cell, and the myxosarcomas. The spindle cell, myosarcoma, chondrosarcoma, and osteosarcoma are made up of well-differentiated cell types. There is usually a mixture of these various types of cells in different parts of the tumor. In 100 cases of ovarian sarcoma,

reported by Wolff, 44 per cent were spindle cell, 38 per cent round cell, 5 per cent mixed, and the remaining 13 per cent were osteo-, myxo-, and melanosarcoma (secondary).

The spindle cell tumors microscopically show a less differentiated fibrillar structure than do the benign fibromas. The cells are more ovoid, and the nuclei stain irregularly. Mitotic figures are frequently seen. Multinucleated cells are not uncommonly found. Areas of necrosis are common.

The round cell type may occur as either small round cells or large round cells. Occasionally they assume an alveolar arrangement. Necrosis and hemorrhage are very common in these rapidly growing tumors. The small cells somewhat resemble lymph cells.

Durfee, Clark and Peers reported a primary lymphosarcoma of the ovary.

The polymorphous cell or mixed cell variety is characterized by the marked variation in the size and shape of the cells and by the frequent occurrence of giant cells. In the myxosarcomas the so-called star cells are present, containing flagella-like processes.

Secondary.—The melanosarcomas are usually secondary, though they may arise from a melanoma from skin in a dermoid cyst. These contain melanin and have the same characteristics as a melanosarcoma elsewhere. Other secondary sarcomas present the characteristics of the growths from which they come. Fig. 1032 shows a sarcoma of the ovary secondary to a sarcoma arising in a uterine myoma. A rapidly growing sarcoma furnishes good examples of mitosis (Fig. 1033).

The well-differentiated cell tumors rarely recur when removed early. The less differentiated tumors, especially the alveolar type, are most malignant and usually recur within two years. Operative cures in some series run as high as 33 per cent.

Diagnosis and Treatment

Owing to the rarity of solid tumors of the ovary and the absence of distinctive symptoms, the **diagnosis** is usually made only after the abdomen is open. In the case of a firm mass presenting the symptoms and signs already described for a small ovarian tumor (except fluctuation) a probable diagnosis of solid tumor of the ovary may be made.

If there is ascites, the fluid from tapping should be centrifuged and the residue fixed, cut and stained for microscopic examination. It may show cancer cells and even a special type of cancer cell, thus permitting a very definite diagnosis.

The great majority of ovarian carcinomas occur in the ages between forty and sixty. Lynch in his instructive paper reviewing 110 cases of ovarian cancer presents an *age-incidence* chart, a *duration of disease* chart covering 49 cases, and a *survival* chart covering 62 cases.

The **treatment** for every solid tumor of the ovary is prompt removal by operation. Prompt removal is important because of the frequency of malignant development. If the growth is already inoperable, then deep x-ray treatment is advisable and may give considerable relief.

In regard to ovarian malignancy brought to light at operation, several important questions arise, including the following: What types of operation

should be employed in the different conditions found? Is irradiation treatment afterward of definite value? What is the prognosis (patient's life expectancy) in the various classes of ovarian malignancy? Help on the problems in this connection has been given by several writers in reporting series of cases.

Montgomery and Farrell, in reporting 22 cases, reviewed the literature and found that of the nearly one thousand cases of ovarian carcinoma reported, very few were recorded in sufficient detail to be used in a critical analysis of results. Among the conclusions at the close of the analysis of their cases are the following:

A comparison of the results of treatment in various series of reported cases of ovarian carcinoma is difficult because of the lack of uniform data. If accurate statistics as to the efficacy of any treatment are to accumulate, it is important that the histologic type of tumor, its grade of malignancy, degree of operability, and the amount of irradiation administered be noted in case reports.

The histologic grading of malignancy is important in the prognosis of ovarian carcinoma. Only one patient in our series whose tumor was of high-grade malignancy has survived for more than five years. All others with tumors of intermediate and high grades of malignancy are dead. Those with tumors of the intermediate grades lived longer than those in whom the malignancy was of a high grade. The more completely operable the tumor the greater the life expectancy.

Postoperative roentgen irradiation is often of value in relieving pain and ascites and in reducing the size of the tumor. Comparison of this series of patients given postoperative irradiation with a group treated by operation alone, indicates that the duration of life is longer in the irradiated patients. Nearly all patients with ovarian carcinoma, regardless of the hopelessness of the prognosis, where the general condition permits, should have postoperative irradiation.

Pathologic Grading.—The details of pathologic grading of ovarian carcinomas, representing degrees of malignancy, are described and illustrated under Pathology.

Clinical Grouping.—The importance of the clinical grouping of ovarian carcinoma cases is emphasized by Montgomery and Farrell, and the grouping they suggest is a practical and helpful one. The essential features are as follows:

Clinical Group I. The tumor is completely removable, and without involvement of any other structure, as far as can be determined at operation.

Clinical Group II. The tumor is completely removable, but with some disturbance of other structures, such as adhesions or involvement of another structure which can be removed (e.g., the other ovary, bilateral tumors).

Clinical Group III. The tumor is only incompletely removable, on account of definite extension to structures left. This group includes all cases in which a partial operation is done, with the hope of taking care of the remaining part by irradiation.

Clinical Group IV. The tumor is irremovable, because of extensive involvement of adjacent parts or because of distant metastasis. Only a specimen of the growth can be removed at the operation.

Types of Treatment.—In an interesting paper on ovarian tumors, H. C. Taylor, Jr., presents the following helpful suggestions as to the handling of patients with carcinoma of the ovary:

At three stages in the treatment of a case of ovarian carcinoma, decisions must be reached as to the course to be followed. (1) When the patient is first seen, whether an operation is to be performed; (2) when the abdomen is open, how extensive an operation is to be undertaken; and (3) after the operation is complete, whether x-ray is to be given.

1. *Operability.*—In many cases of ovarian cancer a definite diagnosis is not arrived at till the abdomen has been opened, so that one must recognize laparotomy as usually the first procedure. This should not, however, be the invariable approach because the surgical exploration of advanced cases is accompanied by a high mortality rate.

Attempt should be made, therefore, to eliminate two categories from the group to be operated upon. (1) In all cases of apparently malignant ovarian tumor the possibility of the growth being secondary in the ovary must be thought of. X-rays of the gastro-intestinal tract should be made, and operation given up when any other lesion besides the ovarian is discovered. (2) Certain very advanced cases with ascites, cachexia, large pelvic tumors, and upper abdominal masses, are readily recognizable as inoperable, and these cases should have their treatment limited to external radiation.

2. *The Extent of the Operation.*—When at the time of operation the growth is found apparently confined to one or both ovaries, there is a general agreement that a complete hysterectomy should be performed, with the removal of both appendages. The preservation of an apparently uninvolved ovary is rarely to be considered, for as Norris has shown, in 17.5 per cent of such cases the grossly normal ovary is later found in the laboratory to contain foci of cancer cells.

The extension of the operation to the removal of single metastatic lesions from organs outside of the pelvis is a dubious procedure. Only in the case of an isolated metastasis in the omentum whose removal does not increase the severity of the operation to an appreciable degree, is such a procedure justifiable, and one patient so treated at the Roosevelt Hospital was in good health when last seen four years after her operation. Resection of part of the bladder or intestine was carried out in a few of the earlier cases but proved both futile and dangerous.

When cancer is found widely disseminated on the pelvic or general peritoneum, a question arises as to whether any surgical procedure should be carried out. Such a condition was found in approximately half of the Roosevelt primary cases. It has been our practice under such conditions to remove as much of the tumor tissue as possible, partly because of the temporary palliation, partly because of the improved psychologic effect on the patient resulting from the disappearance of visible evidence of tumor, partly because of the possibility that x-ray may be more efficient when directed at smaller masses of tissue.

3. *Postoperative Radiation.*—In view of the bad results obtained by the simple surgical treatment of ovarian cancer, postoperative radiation therapy should be given in practically all cases. This opinion is held as a result of favorable reports from outside sources although our own series shows no cures and no increase in the average duration of life attributable to x-ray or radium therapy. The relative failure in this series is very likely dependent upon inadequate dosage.

Kean's conclusions in reporting work of the New York Cancer Institute are as follows:

All cases of ovarian carcinoma should be treated by surgery and irradiation.

Many types of carcinoma of the ovary are radiosensitive.

Life is definitely prolonged in many cases where surgical treatment has been combined with irradiation, as against those patients who had surgical treatment alone.

Even in hopeless cases the patient may benefit a great deal by palliative x-ray therapy.

This corresponds with the experience here (Mallinckrodt Institute of Radiology, furnishing x-ray service to the Washington University Group of Hospitals), both as to our personal experience in having patients definitely benefited by the x-ray treatment and as to the general experience of the Institute.

When the diagnosis of malignancy is fairly certain and the patient is in or past the climacteric, it is advisable to give the radiation (deep x-ray therapy) before operation. This preliminary radiation checks the carcinoma activity temporarily and lessens the danger of spreading active malignant cells in the operative area. It is well to wait some weeks after the radiation before doing

the operation—long enough to obtain the desired cancer-cell devitalization from the x-ray and for the patient to make good recovery from the digestive disturbance of this deep therapy.

When the diagnosis is doubtful and there is a fair chance of nonmalignancy, and especially in younger patients, operation at once is advisable, the question of radiation treatment being postponed till the diagnosis is settled at operation or by subsequent microscopic examination.

Taylor gives in a recent article the changing conception of ovarian tumors, and tackles again the old and ever-new subject of classification.

The Question of Operation

Reviewing the subject of ovarian cancer, with its symptomless development and the possibility of malignancy in any uncertain ovarian mass, there stands out one question of special importance in regard to every mass felt in this region, namely, "Is operation needed or not needed?"

The advisability of operation in any case depends on the character of the mass and the symptoms resulting from it. A definite diagnosis identifies the character of the mass. In some cases the differential diagnosis can be made with reasonable certainty. In other cases the diagnosis remains doubtful despite the use of the various diagnostic measures.

The pathology, symptomatology, and diagnosis of the various types of ovarian tumors have been considered in detail and we shall now pass to certain points of special importance in deciding what should be done for the patient. We shall consider first the cases in which the diagnosis is clear, and afterward the cases in which the diagnosis is doubtful.

Diagnosis Clear.—In these cases in which the diagnosis is fairly clear as to the character of the mass, one may be guided by the following general statements:

Follicular cysts and *corpus luteum cysts* seldom require operation. These cysts are usually small and are not likely to increase to a serious extent. Occasionally an ovary thus enlarged will prolapse and give persistent symptoms requiring operation, or still more rarely, such a cyst will enlarge sufficiently to cause symptoms from pressure or from torsion of the pedicle. But usually these simple cysts do not cause symptoms nor necessitate operation. Most of those which are removed are so treated incidentally in the course of an operation for some more serious trouble.

Theca-lutein cysts (due to hydatidiform mole in the uterus) are enormously enlarged graafian follicles. This great enlargement of the ovarian follicles is due to the excessive formation of stimulating hormones by the cells of the new growth in the uterus. When this excess hormone formation is stopped by removal of the uterine growth, the giant follicles may return to near normal size. Hence, they should be given a chance to do so without abdominal operation, except in those cases where they are already causing serious pressure disturbance.

Even when the cystic enlargement of the ovaries is so great as to cause marked abdominal enlargement, the plan of treatment is to eliminate the hydatidiform mole by uterine curettage and give a chance for the ovarian enlargement to subside without operative disturbance of the ovaries. Thus, the ovarian endocrine function and the possibility of future childbearing are preserved.

When the abdomen has been opened under the tentative diagnosis of an ovarian cyst requiring removal, if both ovaries are found to be involved by many cysts with very thin walls and clear contents, care should be taken to eliminate hydatidiform mole of the uterus with resulting theca-lutein cysts of the ovaries before doing radical surgery on the ovaries.

Involvement of the ovaries by theca-lutein cysts is so extensive and deep-seated as to give the impression that all ovarian tissue and ovarian function are already destroyed and hence excision of the cysts and ovaries is needed. But in reality there is much ovarian tissue left, though it is so thinned out by the crowded cysts that it cannot be identified. A history of recent menstruations indicates functioning ovarian tissue despite the deceptive appearance. If menstruation has been missed for a month or two, this should arouse suspicion of early pregnancy with possible hydatidiform mole and resulting theca-lutein cyst enlargement of the ovaries. Irregular bloody discharge with undue cystic enlargement of the corpus uteri (beyond that expected from the duration of pregnancy) are further indications of possible hydatidiform mole formation.

In such circumstances radical operation on the ovaries is contraindicated. The larger cysts may be punctured to relieve pressure, the abdomen closed, and then the uterus curetted. The curettage may bring out the small grapelike cysts characteristic of hydatidiform mole, and thus at once confirm the diagnosis. At any rate, the curettage will give tissue for microscopic examination and elucidation of whatever pathological process is going on in the uterus.

The Aschheim-Zondek test is helpful not only in the early diagnosis of hydatidiform mole, but also in determining whether active chorionic tissue persists after curettage. If the microscopic investigation of curettings shows chorioepithelioma, appropriate radical measures are to be employed promptly.

A small *parovarian cyst* may cause no symptoms and show no tendency to increase in size, in which case operation is not necessary. Such a cyst, however, should be watched by check-up examinations, that any tendency to progressive increase may be noted.

Endometrial cysts are very erratic in growth and in the causation of symptoms. Incidental findings at operation and in postmortem work indicate that small areas of endometriosis may remain quiescent indefinitely. Hence small to medium endometrial lesions which consist principally of firm induration back of the uterus laterally and cause no serious symptoms do not require operation. Accompanying distinct cyst formation, however, indicates a stage of progress which usually requires operation.

All other growths of the ovary, such as the proliferating cyst, dermoid, teratoma, granulosa-cell tumor, arrhenoblastoma, dysgerminoma, Brenner tumor, carcinoma, and sarcoma, require operative removal because of the pathological character, which threatens the life of the patient. Such growths, even though not yet causing troublesome symptoms, should be removed promptly. The risk of operation in such a case is much less than the risk of waiting.

Of course any ovarian growth causing troublesome symptoms, even the simple growths previously mentioned, should be removed unless there is some overbalancing contraindication.

Diagnosis Doubtful.—When the exact character of the mass still remains doubtful after careful analysis of the history and examination findings, the diagnostic problem shifts to a group determination. Is this lesion one of a group requiring operation or one of a group in which operation is contraindicated?

In settling this point we must consider the various conditions which may be present. In doing so we must keep in mind not only primary conditions but also possible complications. For the purpose of such consideration the cases may be divided into two groups, one presenting a medium-sized mass as the principal feature, and the other presenting an enlarged abdomen.

Medium-sized Mass.—A mass of moderate size (from medium orange to large grapefruit) without acute symptoms may be due to ovarian tumor, full bladder, uterine pregnancy, tubal pregnancy, myoma, chronic adnexal inflammation, pelvic endometriosis, pelvic tuberculosis, or some extragenital conditions, such as diverticulitis, tumor of sigmoid, cecum, or rectum, or a mass from the urinary tract.

If acute symptoms are present, we must consider ovarian tumor with complications (torsion of pedicle, inflammation, endometriosis, intracystic hemorrhage or appendicitis), tubal pregnancy, uterine pregnancy with complicating inflammation, myoma with associated appendicitis or salpingitis, and extragenital conditions which might give rise to a painful mass in this area.

In the groups requiring operation may be placed ovarian tumor with troublesome symptoms (whether the symptoms are from the tumor or from some complications that can be taken care of at the operation), tubal pregnancy, and appendicitis. In the group in which operation is contraindicated may be placed at once uterine pregnancy (except when there is some special complication), acute salpingitis, and the extragenital conditions with the exception of appendicitis. In these cases of possible extragenital lesion, operation is contraindicated until the required extragenital investigation and decision.

It is clear then that before advising operation we must exclude uterine pregnancy (except when complicated by some definite operative indication), acute salpingitis, and extragenital lesions except appendicitis. In cases in which pregnancy cannot be otherwise definitely excluded, an Aschheim-Zondek test may settle that point. It may become positive by the time menstruation is first missed or it may continue negative for six weeks of pregnancy. A positive reaction, however, indicates only that there are active fetal elements somewhere in the patient. Whether they are in the uterus or in the tube must be determined by other examination findings.

A filled or partially filled bladder may give a very deceptive cystic mass in the pelvis and in some cases catheterization may be necessary to exclude it. In those cases in which extragenital lesions cannot be clearly excluded as the cause of the mass, it is ordinarily advisable to have a gastrointestinal x-ray series in the possible intestinal cases and a cystoscopic investigation in the possible urinary-tract cases.

Before advising against operation we must exclude ovarian tumor with troublesome symptoms, tubal pregnancy, and appendicitis (either as a primary condition with a large mass of exudate or as an active complication of some other mass). Until these menacing conditions are definitely excluded, the case must be considered possibly one for prompt operation.

In myoma, chronic adnexal inflammation, pelvic endometriosis, and pelvic tuberculosis, operation may or may not be required, depending on the particular conditions present in each case. The determining conditions for each type of lesion are considered in the appropriate chapter.

Enlarged Abdomen.—In a doubtful case where the principal feature is enlargement of the abdomen, presumably by an ovarian tumor, the other conditions to be considered are obesity, tympanites with relaxed wall, ascites, encysted fluid (peritoneal tuberculosis), uterine pregnancy, extrauterine pregnancy, large myoma, distended bladder, hydronephrosis, pancreatic cyst, and enlarged spleen or liver.

All of these conditions are of gradual development, and the absence of acute threatening symptoms permits taking sufficient time for deliberate investigation of all the possibilities. Such differential diagnostic investigation carried out systematically to the limits, usually clears up the case as far as important uncertainties are concerned. In this connection the following special points should be kept in mind. Extrauterine pregnancy may advance to term with a remarkable absence of acute symptoms. A large myoma may have a considerable portion cystic, thus adding to the difficulties of differential diagnosis. A chronic distention of the bladder may be obscured by the statement of the patient that she passes urine frequently (distention with overflow). Some cases of peritoneal tuberculosis advance to abdominal enlargement with very few subjective symptoms, and the same may be said of hydronephrosis and of pancreatic cyst, hence the necessity for considering these lesions in all doubtful cases.

In the group of lesions requiring operation may be placed large ovarian tumor, extrauterine pregnancy, and large myoma. The group not requiring operation includes obesity, tympanites with relaxed wall, pregnancy, and distended bladder. In ascites, encysted fluid (from tuberculosis or ordinary chronic inflammation), hydronephrosis, pancreatic cyst, and enlarged spleen or liver, the decision as to operation for the lesion depends on the particular conditions in each case.

In cases of very large ovarian or parovarian tumor, the patient may be in such bad condition generally or locally as to make doubtful the advisability of attempt at radical operation. The special difficulties resulting from the great size of the growth are largely due to pressure. Though the abdominal structures will accommodate themselves in a remarkable way to a gradually enlarging mass, a limit is finally reached beyond which serious disturbances result from the pressure. The upward pressure crowds the diaphragm

and heart and lungs, causing at first disturbance on exertion and later necessitating the upright position in bed. Pressure on the large vessels causes edema of the lower extremities. Pressure on the deep vessels causes enlargement of the collateral vessels in the abdominal wall. Finally, pressure on the abdominal wall causes an increasing edema there, sometimes interfering with the circulation so much that dermatitis and superficial ulceration result.

These cases present a serious problem in handling so as to do what is necessary to put the patient on the way to recovery without at the same time upsetting her precarious reserve of vitality. The complications may interfere with complete examination, leaving one doubtful whether the condition is really ovarian cyst or ascites or a combination of the two. When the regular systematic differentiation has narrowed the diagnosis to this extent, there is a *temptation to employ paracentesis*, with the idea that it will easily settle the matter. There are some points to consider, however, before resorting to paracentesis in such a doubtful case. If it is an ovarian cyst, there is some danger of intestinal puncture. Though usually the intestines are pushed up above the tumor, a coil may be adherent anywhere over the anterior surface, especially in cases preceded or accompanied with inflammation. Again, there may result infection of the trocar-tract in the poorly nourished abdominal wall, thus interfering with subsequent operation. Third, the information gained by paracentesis is very limited compared to that supplied by a small abdominal incision and intraabdominal palpation.

Consequently, in the cases in which ovarian tumor cannot be excluded, the preferable plan usually is to prepare the patient for abdominal operation and then under local anesthesia open the peritoneal cavity by a small median incision. This incision may be made with the patient propped up, if the pressure-dyspnea prevents lying down. If an ovarian cyst is found, it may be tapped in a safe way and emptied to relieve the diaphragm pressure, after which the patient may lie down for respiratory anesthesia if such is required for the removal of the tumor.

In these doubtful cases this open incision is safer than the blind puncture of paracentesis, yields more important diagnostic information, and permits removal of the tumor if such is found. If the doubtful condition proves to be ascites, information obtained through the open incision will indicate whether the ascites is due to liver disease or to malignancy at some other location in the cavity. Also, if the ascites is due to liver disease, helpful collateral circulation may be established by attaching the omentum to the abdominal wall.

Later publications emphasize two important points in connection with ovarian malignancy. Palliative medication in inoperable cases has been made more effective by the employment of androgen therapy. Beecham reviews the subject and also reports a group of cases in which the administration of testosterone propionate gave rapid and marked relief from pain, in addition to improving general condition.

In regard to diagnosis, the early stages of ovarian carcinoma are so symptomless that the growth is nearly always overlooked by both patient and physician until it has advanced to a stage beyond cure. The serious menace of "silent" ovarian carcinoma is considered with illustrative cases in a 1942 article by Crossen, along with details of effective remedial action.

MALFORMATIONS

The growth of an organ may be simply arrested or it may grow in the wrong way. In either case there results a malformation. Most genital deformities are due to partial arrest of development. To understand these malformations, it is necessary to understand something about the development of the organs.

POINTS IN DEVELOPMENT

The first structures indicative of the genitourinary organs are the **wolffian ducts,** which appear in the embryo about the fifteenth day, and the **wolffian bodies,** which appear on the eighteenth day. These structures represent the future kidneys and genital apparatus. They lie on each side of the median line.

During the fourth week another duct appears near the wolffian body on each side. These are the **muellerian ducts.** The wolffian ducts go to form the excretory ducts of the genital apparatus in the male. The muellerian ducts go to form the excretory ducts of the genital apparatus in the female. A part of the wolffian body of each side finally forms the genital gland of that side, i.e., the ovary in the female and the testicle in the male.

At the end of the first month the middle part of each wolffian body shows thickening and proliferation, resulting in the formation of elevated bands called "genital ridges." These are the earliest traces of the genital glands. For a few days they remain indifferent. Very soon, however, a difference in the two sexes is noticed. The primitive female gland "possesses a large number of the primitive sexual cells and evidences a tendency of its elements to arrange themselves into groups, in which the large primitive ova become central figures." The primitive male gland, on the other hand, shows a tendency to the formation of a network of cell cords—the forerunners of the seminiferous tubules. "Microscopic examination of the sexual primitive glands even at the end of the fifth week is capable of distinguishing the future sex of the being." In a short time there is a difference in the gross appearance of the gland, with a difference in the arrangement of the ducts.

The parts played by the wolffian ducts and muellerian ducts differ in the two sexes. In the **female** the muellerian ducts are the most important. The lower portions of the ducts of Mueller become fused and form the vagina and uterus, and the upper portions remain separated and form the fallopian tubes (Figs. 1034 to 1036). The lower end of the canal (future vagina) formed by the fused muellerian tubes is closed at first. Later the lower part of the septum, which shuts off this canal from the urogenital sinus, breaks down, permitting the canal (vagina) to communicate with the urogenital sinus. If this septum fails to break down, imperforate hymen results. The very end of
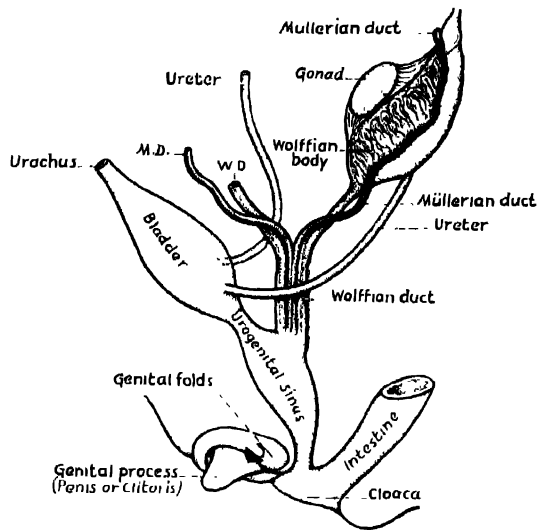
Fig. 1034.
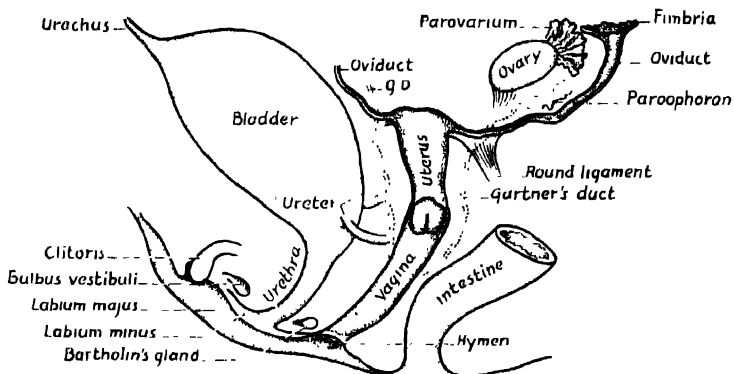
Fig. 1035.
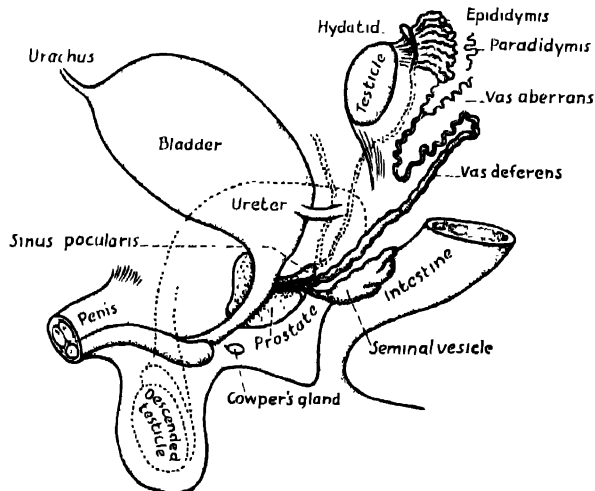
Fig. 1036.

Figs. 1034, 1035, and 1036.—Development of the Genital Organs. Diagrams illustrating the transformation of an indifferent primitive genital system into the definite female and male types. (Modified from Arey, after Thompson—*Developmental Anatomy.*)

the other extremity of the muellerian duct is usually represented by a miniature cyst attached to one of the fimbria and called the "hydatid of Morgagni."

The wolffian body forms the ovary and also contributes the transverse tubules of the parovarium. The upper part of the wolffian duct remains as the "head tube" of the parovarium. The lower part of the wolffian duct some· times remains in whole or in part, and is then known as "Gärtner's duct'
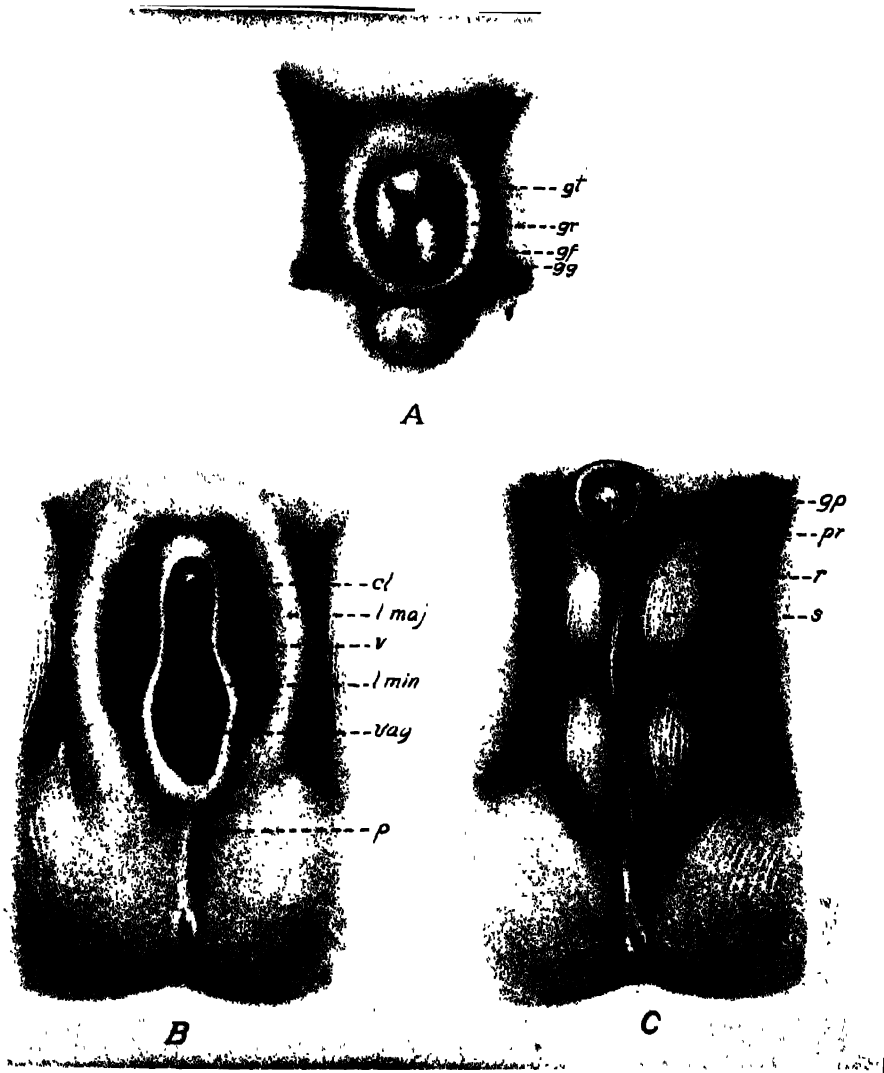
Fig. 1037.—Development of the external genitals (after Ecker-Ziegler models). *A*, Indifferent stage (eighth week); *gt*, genital tubercle; *gr*, genital ridge; *gf*, genital fold; *gg*, genital groove. *B*, Female type; *cl*, clitoris; *l. maj.*, labia majora; *v*, vestibule; *l. min.*, labia minora; *vag.*, vagina; *p*, perineum. *C*, Male type; *gp*, glans penis; *pr*, prepuce; *r*, raphe; *s*, scrotum.

(Figs. 48, 49). These parovarium tubules are all atrophic structures of but little importance. The ovary is the important organ formed from the wolffian body in the female.

In the male the wolffian tubules and wolffian duct contribute the important system of excretory tubes represented by the vas deferens and the epi-

didymis, while the muellerian duct is atrophic, its ends alone remaining. Its outer end forms the "hydatid of Morgagni," closely connected with the epididymis, and its inner end forms the "sinus pocularis," or "uterus masculinus," opening into the prostatic portion of the urethra.

External Genitals (Fig. 1037). "Until the ninth or tenth weeks the external genitals afford no positive information as to sex"—they are indifferent. They then begin to differentiate and "usually by the end of the third month the external sexual organs are characteristic beyond doubt." Up to the sixth week the external openings of the intestine and of the urinary apparatus are received within a common cloacal recess whose rectourogenital orifice is surmounted by a small conical elevation, the "genital tubercle." The lower and posterior surface of the genital tubercle is divided by a furrow—the "genital groove"—bounded by thickened edges called the "genital folds." Gradually a septum develops, separating the rectal opening from the genitourinary opening. The "genital tubercle" forms the **clitoris** and the "genital folds" form the **labia.**

The **vestibule** is formed by the cloaca or common opening of the intestinal tract and urinary tract in the early embryo. The **perineum,** developing, separates the rectum from this common vestibule. And the septum (hymen) closing the end of the rudimentary vagina (fused muellerian ducts) breaks, allowing the vagina to open into the vestibule. This opening through the septum varies much in size, shape, and situation, giving the various forms of opening found in the hymen. It is usually small, and roughly crescentic in shape.

The **vagina** is formed by the fusion of the lower portions of the two muellerian ducts and the absorption of the longitudinal septum between the cavities. The **uterus** is formed by the fusion of the middle portions of the two muellerian ducts and the absorption of the septum between the cavities. The **fallopian** tube of each side is formed by the upper portion of the muellerian duct of that side. The **ovary** of each side is formed from a portion of the wolffian body of that side. The **parovarium** consists of the "transverse tubules," which are formed from the wolffian body, and the "head tube," which is formed from the wolffian duct. The **paroophoron,** lying in the broad ligament near the parovarium, is the atrophic remains of the lower segment of the wolffian body.

ANOMALIES OF DEVELOPMENT

The more common anomalies of development are as follows:

1. A septum is found between the vaginal cavity and the urogenital sinus, constituting **imperforate hymen** (Figs. 1038, 1039).

2. More rarely, perfect canalization does not take place in the fused muellerian cords (each of which develops a central canal and becomes a muellerian duct), resulting in a closed place at some point in the canal, giving **atresia of vagina** (Fig. 1040) or atresia of cervix. In very rare cases all of the lower fused cords fail to canalize, causing **absence of vagina** (Fig. 1047).

3. The septum between the two fused muellerian ducts may persist all the way to the hymen, in which case there exists **double vagina** (Figs. 1048, 1049).

4. The vagina may open into the urethra instead of into the urogenital vestibule. This gives the anomaly shown in Figs. 1050 to 1053.

5. The septum may persist into the uterine portion of the muellerian tract, forming a uterus septus.

6. The middle portions of the muellerian ducts may fail to fuse, giving a double uterus (uterus didelphys).

7. They may fuse only imperfectly, giving a uterus with rudimentary horns. There may be either two well-marked horns (uterus bicornis), or a fairly well-developed uterus with one rudimentary horn, as shown in the illustrations.

8. The wolffian duct may persist in some extent, giving a duct lying alongside the vagina called Gaertner's duct (Figs. 48, 49). This may extend all the way along the vagina and open near the hymen, or there may be only

Fig. 1038.

Fig. 1039.

Fig 1038.—Imperforate hymen. There is no vaginal opening, the urethra being the only opening present in the vestibule. (Montgomery—*Practical Gynecology*.)

Fig. 1039.—Hematocolpos, which may result from imperforate hymen or from atresia at the lower portion of the vagina. The menstrual blood has not yet distended the uterus. (Montgomery—*Practical Gynecology*.)

remnants of the tube here and there. These remnants sometimes develop so as to form small vaginal cysts. Such cysts are situated in the vaginal wall along the course of the atrophic wolffian duct. This duct extends through a portion of the uterine wall, and a uterine tumor may arise from it.

The above mentioned are the principal gross developmental anomalies ordinarily met with. There are many other rarer anomalies, of which lack of space prevents mention. These vary in each organ all the way from slight modification to complete absence. The ovary is probably the least frequently affected by anomalies, and yet, as rare as they are, they have produced many surprises in abdominal work, especially in the cases of pregnancy following the supposed complete removal of both ovaries. This means, of course, that some ovarian tissue remains, and it is usually said to be a "third ovary."

While the development of three normal ovaries is not impossible, the condition present in the cases under consideration is, as a rule, "lobulation" of the ovary of one or both sides, and not the presence of a complete third ovary. The lobulated ovary may show only a marked constriction, or it may be divided into two or three or many separate lobules, with considerable space between various lobules. Bovée mentions a case of his in which the ovary of each side was represented simply by numerous small particles of ovarian tissue scattered over a large area of the posterior surface of the broad ligament, and resembling verrucal excrescences. It is evident that in such a case some outlying nodules of ovarian tissue would almost certainly be missed, especially if obscured by an inflammatory exudate.

The malformations most commonly requiring treatment are:

Imperforate Hymen. Vagina Opens Into Urethra.
Atresia of Vagina. Malformations of Uterus.
Double Vagina. Pseudohermaphroditism.

Imperforate Hymen

If the time-honored supposition that the hymen is simply the remains of the septum between the embryonic vagina and the sinus urogenitalis is true, then imperforate hymen means the failure of this septum to break down. If, on the other hand, the hymen represents another structure formed by active circular proliferation just back of the septum area, then imperforate hymen or occluded hymen is the result of excessive proliferation and coalescence, instead of failure to break down. Taussig has investigated this subject embryologically and in two articles presents substantial points in favor of the proliferation theory.

Imperforate or occluded hymen causes no disturbance until puberty. After puberty there is a collection of menstrual blood back of the imperforate hymen (Fig. 1039). This gradually increases in amount and distends the vagina. If the obstruction is not relieved, there is gradual dilation of the uterus and even of the fallopian tubes, forming a cystic mass, the content of which is blood and the walls of which are formed by the vagina and uterus.

The **symptoms** are characteristic. At the age of puberty no menstruation appears, but about every four weeks the patient feels ill, with pain in the lower abdomen and the usual disturbances accompanying menstruation. The mother supposes that the girl is going to menstruate, but there is no flow. This is repeated month after month. As the collection of blood increases, the pain and disturbance become more marked, the patient's health begins to suffer, and a tender mass appears in the lower abdomen. Finally the patient becomes so sick that the physician makes a local examination. He finds that there is no vaginal opening, but instead there is a fluctuating mass occupying the position of the vagina and uterus (Fig. 1039).

The **treatment** is crucial incision of the distended hymen, and, if the membrane is thick, excision of the most of it. The cavity above should be washed out with normal saline solution and then packed with sterile gauze. Great care is necessary to prevent infection. The decomposing blood that

necessarily remains along the walls of the cavity favors the rapid growth of pus germs, and, though the operation is a simple one, patients have died from it, or rather from the infection following.

Tompkins reported a series of five cases of imperforate hymen with hematocolpos and collected 113 from the literature, and presented a study of diagnosis and treatment.

Atresia of Vagina, Absence of Vagina

The method of origin of this malformation has been explained. The condition may vary all the way from a thin septum blocking the canal to complete absence of the canal. The external genitals may be normal.

The serious conditions which may result from simple atresia of the vagina, and the importance of early investigation of symptoms, such as amenorrhea and slight recurring abdominal pains, are demonstrated in the following case of ours:

Miss D., aged twenty-three years, was referred for operation for pelvic tumor. Examination showed a tender mass filling the central pelvis and a mass on each side extending into the lower abdomen. The upper limits could not be outlined on account of the deep location and the tenderness. The patient had a temperature of 104° F. and was in a serious condition. On vaginal examination an obstruction was found just inside the vaginal opening, and there was a bloody discharge mixed with pus. The history was somewhat uncertain and there were other factors that made diagnosis of intrapelvic conditions difficult, but facts were eventually established to warrant a diagnosis of the following sequence of events.

The patient had atresia of the vagina near the outlet, as indicated in Fig. 1040. After puberty there was a slow accumulation of menstrual blood back of the obstruction, as indicated in Figs. 1041 to 1044. There had been no menstruation. She had had abdominal pains off and on, and on going over the matter she thought they had been worse about once a month for several months past. Apparently they were never very severe.

About a month previous to her admission to the hospital a slight bloody discharge appeared. Apparently the pressure of the accumulating blood had gradually stretched the thin membrane occluding the vagina so much so as to cause a small opening through which came the slight bloody flow, as shown in Fig. 1045. This flow continued for a week or so and then the patient became suddenly very ill, with high fever.

Bacteria eventually propagated in this bloody culture medium, followed up the stream into the mass of old blood, and then multiplied rapidly, forming an abscess involving the distended vagina and uterus and tubes, as indicated in Fig. 1046.

The plan of treatment was to drain from below. This might prove sufficient, and the anesthesia and vaginal work would permit deeper examination for confirming or disproving the diagnosis made. There was of course the possibility that the diagnosis was erroneous and that the large masses above were tumors, with degeneration or suppuration or twisted pedicle. The vaginal drainage improved conditions temporarily and the information obtained tended to confirm the diagnosis of genital tract distended with blood and infected.

In three days the temperature became high again, there was no diminution in the size of the lateral masses, and it was evident that abdominal operation was necessary in spite of the danger it involved. At the abdominal operation the tubes were found enormously distended, pushing up the sigmoid and the cecum. The distended tubes and uterus were removed and extensive drainage was established. Examination of the distended tubal specimens showed them filled with a mixture of pus and old blood. The patient had a stormy time, but eventually recovered.

On making the vaginal **examination**, an obstruction is met with at some point in the vagina. If there is a collection of menstrual blood back of the septum, fluctuation may be detected. Digital examination per rectum will **give some**

idea of the extent of the atresia and the amount of blood behind it. If the patient is well past the age of puberty, and there is no fluid above the atresia, the probability is that the uterus is anomalous, so much so that menstruation could not come on even though the obstruction in the vagina were removed. So, before undertaking an operation for making a vaginal canal, rectoabdominal examination, under anesthesia if necessary, should be made to establish the size, shape, and probable development of the uterus. In cases of apparent absence of the uterus, rectovesical examination may be of assistance in locating a small nodule in the situation of the uterus.

The **treatment** depends on the circumstances of the case. If only a thin septum is present it should be treated practically the same as an imperforate hymen—i.e., incised, to let out the blood, and then partially or wholly excised. If a considerable proportion or the whole of the vaginal canal is missing (Fig. 1047) the treatment requires extended operative measures according to the special conditions present. It may be necessary to build up a whole new vagina. The details of this operative work are considered in the authors' *Operative Gynecology.*
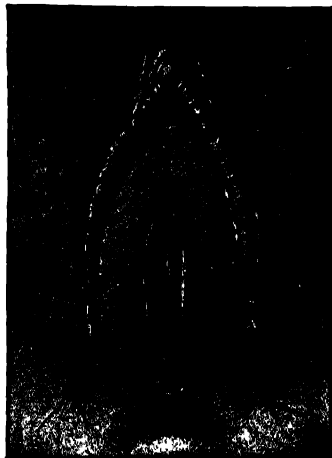
Fig. 1047.—The appearance of the external genitals in a case of absence of the vagina. (Kelly–
Operative Gynecology.)

Acquired Atresia.—A considerable proportion of the cases of marked stenosis of the vagina, amounting almost to atresia, are acquired. Such a condition may result from injuries in childhood or inflammation, particularly the gonorrheal vaginitis of childhood and severe inflammations following the exanthemas. Congenital syphilis also may cause it, following severe ulceration. In later life, scar tissue resulting from injuries in labor is the most frequent cause of narrowings in the canal and bands and constrictions and distortions. Other causes in the adult are syphilitic ulceration, injuries, and severe destructive inflammations. A pessary left in the vagina for several years may lead to such a result. In rare cases even complete atresia may result from some one of these causes. The atrophic vaginitis or "adhesive vaginitis" of old age (senile vaginitis) leads to adhesion of the walls of the vagina and stenosis and partial obliteration of the canal. The treatment for acquired stenosis or atresia of the vagina is practically the same as for the con-
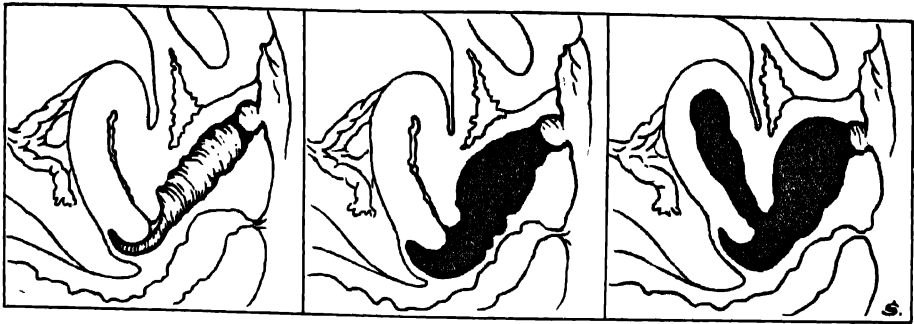
Fig. 1040.   Fig. 1041.   Fig. 1042.

Fig. 1040.—Indicating the Location of the Vaginal Atresia in the case described in the text.

Figs. 1041 and 1042.—After puberty there began an accumulation of menstrual blood, which distended the vagina and later the uterus.
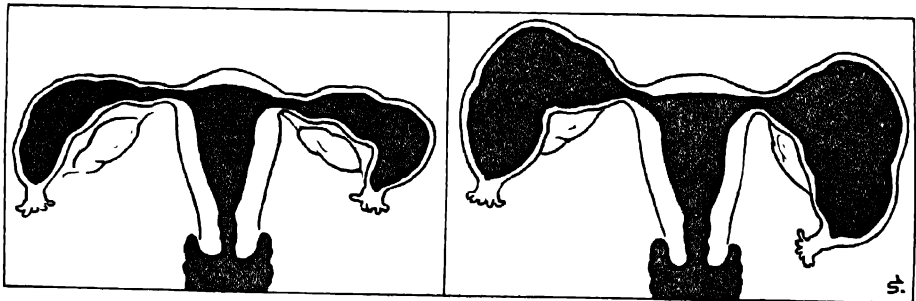
Fig. 1043.   Fig. 1044.

Figs. 1043 and 1044.—The Retained Blood Extended into the Tubes. Peritoneal irritation sealed the outer ends of the tubes, and the accumulating blood caused more and more distention.
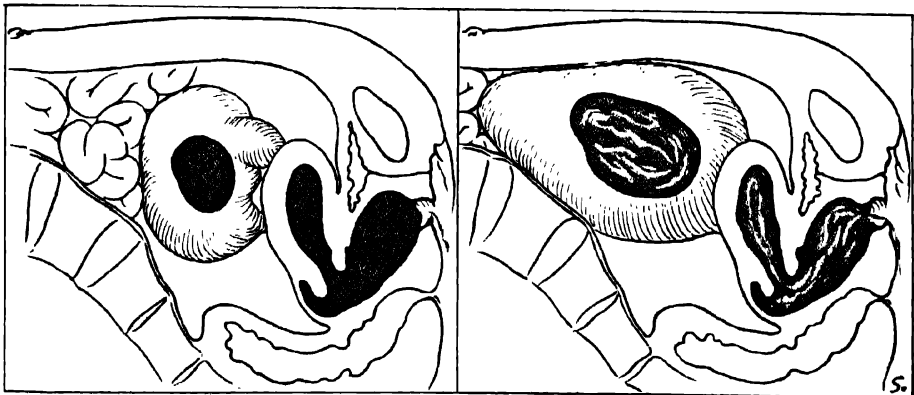
Fig. 1045.   Fig. 1046.

Fig. 1045.—These Blood-filled Masses in the Pelvis and Lower Abdomen had enlarged so gradually that they were not noticed, there being no acute symptoms leading to examination. Finally the vaginal distention thinned the abnormal septum to such an extent that a small opening occurred, and through this there was some leakage of the retained blood.

Fig. 1046.—Along this line of culture medium, inflammatory bacteria propagated into the vagina and then throughout the disintegrating blood mass. There was then rapid enlargement of the tubal masses, marked pain, high fever, sepsis, and the patient passed at once into a desperate condition—with the diagnosis obscure, until worked out as here shown.

genital. The acquired form, however, is, when extensive, likely to be more difficult of satisfactory treatment on account of the large amount of scar tissue in the vicinity.

Double Vagina

This consists usually simply in a longitudinal septum dividing the vagina into two canals (septate vagina). The vagina with entirely separate walls is a much rarer condition. The longitudinal septum is the persisting fused wall of the two muellerian ducts, as already pointed out. It may extend the whole length of the vagina, giving two openings at the vestibule, and half the cervix in each upper end (Figs. 1048, 1049). On the other hand, it may consist simply in a septum extending part way. Even when the septum extends the full length of the vagina, one canal is usually so much smaller than the other and placed so far to one side that it does not interfere with coitus or pregnancy.
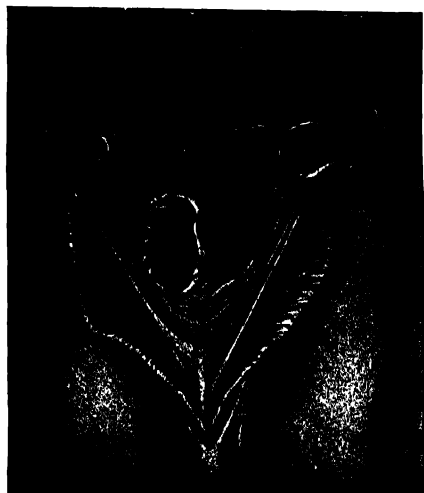
Fig 1048.

Fig. 1049.

Fig. 1048.—The appearance of the external genitals in a case of double vagina. (Kelly—*Operative Gynecology.*)

Fig. 1049.—Same case as Fig. 1048, with speculum introduced, exposing the two vaginal canals and the half cervix at the top of each. (Kelly—*Operative Gynecology.*)

In fact the opening of one canal may be so flattened out at the side of an apparently normal vaginal opening that it is not noticeable except on very close inspection. In such a case, however, when the slit beside the vaginal opening is noticed, further examination may reveal a rudimentary canal of considerable size, sometimes almost as large as the patulous one. At the upper part of each vagina is one-half of the cervix. When labor takes place in a case of double vaginal canal, the septum is likely to be torn, partially or completely, converting the two canals into one. Portions of the septum may remain as a partial septum at the upper part of the vagina or as irregular bands and tags.

The senior author recalls one case of septate vagina and uterus seen in the first pregnancy. The patient passed through labor without particular incident, except that the cervix (half cervix) was very slow in dilating. The lower part of the vaginal septum near the vaginal entrance was torn, but the greater part remained and seemed to occasion no trouble. Later, the patient returned to the

hospital with gonorrhea affecting the vaginal and uterine cavity of each side. Still later, the author was obliged to curette both uterine cavities.

The treatment of double vagina is simple. If the septum is causing any obstruction or disturbance, it is divided or, better still, largely excised, so that the two vaginal canals are converted into one.

Vagina Opens Into Urethra

When examination reveals no vaginal opening at the vestibule, that does not necessarily mean no vagina. There may be a fairly well-developed vagina opening into the urethra.

Fig. 1050.   Fig. 1051.

Fig. 1052.   Fig. 1053.

Fig. 1050.—A malformation consisting of a vagina which opened into the urethra instead of into the vestibule.

Fig. 1051.—Result of operation for opening the vagina into the vestibule and closing the opening into the urethra. (Barrows and Block—*Am. J. Obst. & Gynec.*)

Fig. 1052.—Result of further operation to enlarge the vestibular opening of the vagina.

Fig. 1053.—Front view, indicating the site of the enlarged opening and the appearance of the abnormal clitoris. (Barrows and Block—*Am. J. Obst. & Gynec.*)

Barrows and Block report such a case, in which the patient menstruated through the urethra. The condition is shown in Fig. 1050. Operation consisted of opening the vagina into the vestibule and repairing the urethra, as shown in Fig. 1051. In spite of dilatation treatments some stenosis persisted at the vaginal opening, and this was overcome by incisions, as indicated in Figs. 1052 and 1053.

Eldon reported a somewhat similar case. Young discussed this anomaly at length in his book on genital abnormalities, hermaphroditism and related adrenal diseases, and shows the cystoscopic appearance of the opening into the urethra, and also the cystoscopic appearance of the vaginal wall and cervix. The size of the anomalous vagina may be demonstrated by injection of opaque material.
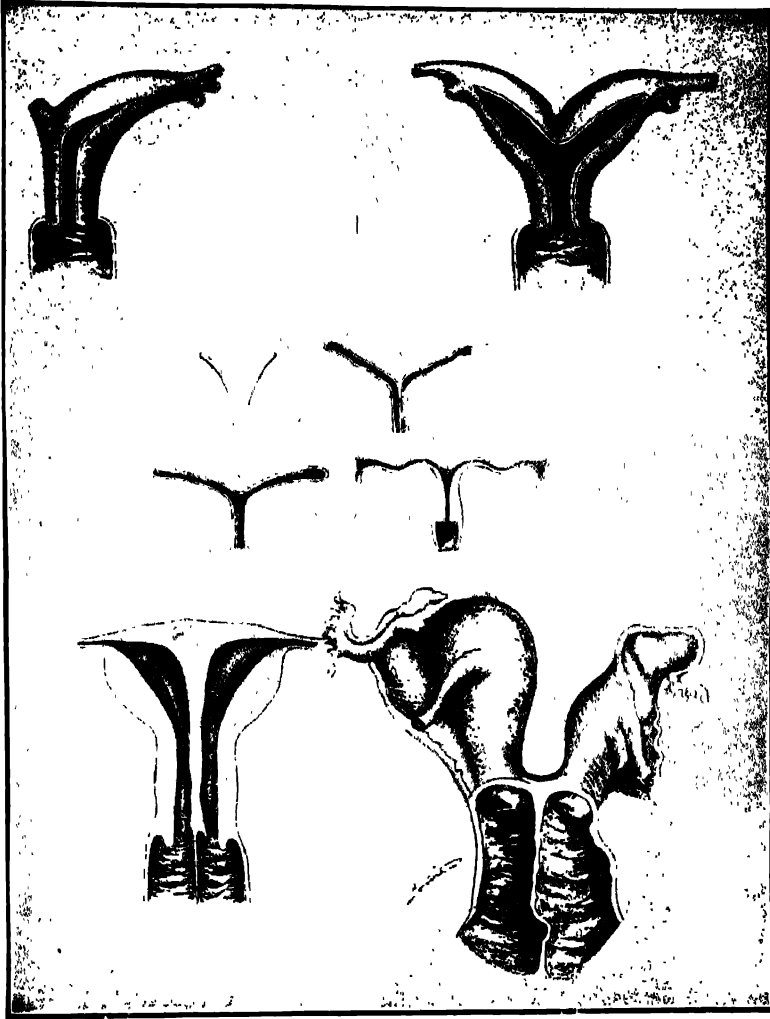
Fig. 1054.—Diagrammatic representation of the development and malformations of the uterus. *1.* Showing the different stages in the union of the muellerian ducts to form the uterus, vagina, and fallopian tubes. *2.* Uterus unicornis. *3.* Uterus bicornis. *4.* Uterus septus. *5.* Uterus duplex. (Gilliam—*Practical Gynecology.*)

Malformations of the Uterus

The formation of the uterus by the union of two tubes and certain malformations that may result are indicated diagrammatically in Fig. 1054. Cases of uterine malformation are illustrated in Figs. 1055 to 1059.

Septate Uterus, Double Uterus.—The malformation may consist simply of a partial or complete septum in an otherwise normal uterus (uterus septate)

or of a rudimentary horn with a nearly normal uterus or of a uterus with a body divided into two horns (uterus bicornis) or of a double uterus, with the body and cervix of one side separate from the body and cervix of the other side (uterus didelphys) or of a "unicorn uterus"—i.e., uterus made up of muellerian duct of one side only, the other being absent or nearly so. The most severe grades of deformity are very rare, though they are to be thought of in the diagnosis in puzzling cases. A septum in an otherwise normal uterus
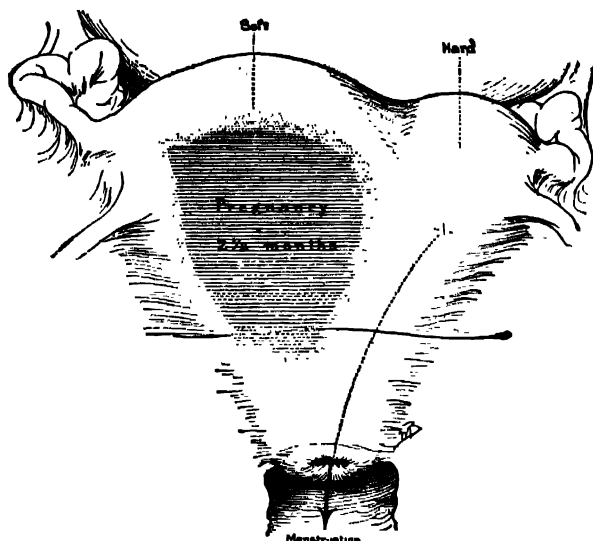
Fig. 1055.—Pregnancy in the right half of a septate uterus. (Kelly—*Operative Gynecology.*)

Fig. 1056.—Lipiodol x-ray of bicornate uterus six weeks after removal of septum. (Luikart—*Am. J. Obst. & Gynec.*)

is discovered only by intrauterine manipulation, such as curettement or the introduction of the hand after labor for the removal of adherent placenta or for other reasons.

No treatment for double uterus is required ordinarily, with the exception of the precaution, when curetting the uterus, to be certain that both cavities are clear. It is appreciated, of course, that in this connection, and also in double uterus, pregnancy may take place in each of the two cavities, and at different times, producing various surprising results.

Shelly reported a case of septate uterus, with adenocarcinoma in one side and a pedunculated polyp in the other, and remarked:

If the curette had gone into the right cavity instead of the left the uterine polyp would have been removed and might well have been considered to be the sole cause of the bleeding. Had this happened, the opportunity for early removal of the adenocarcinoma of the uterus might have been lost, unless there was considerable continued bleeding after discharge from the hospital. When the pieces of adenocarcinoma were obtained with the curette, no additional curetting was done. Had the polyp been removed first, of course, a thorough curettage would have followed. But it is possible to see how the curette might have gone into only one cavity of the uterus.
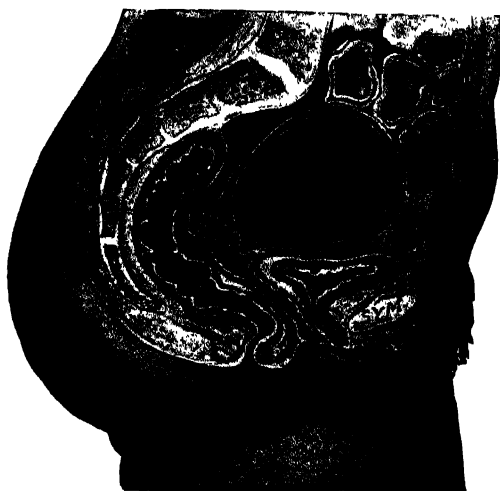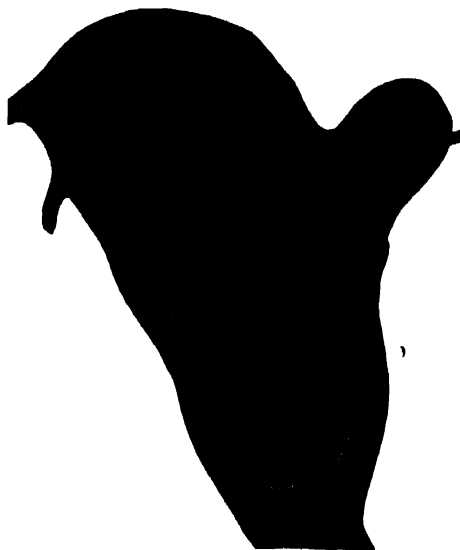
Fig. 1057.   Fig. 1058.

Fig. 1057.—Uterus distended with menstrual blood (hematometra) due to atresia of the cervix. (Montgomery—*Practical Gynecology*.)

Fig. 1058.—Double uterus with atresia in one side. (Montgomery—*Practical Gynecology*.)

If the septum in a uterus gives trouble, it may be removed. Luikart reported such a case, the septum being associated with a bicornate condition of the uterus. Fig. 1056 shows the outline of the cavity after removal of the septum. This method of outlining by opaque injection and x-ray may be employed for diagnosis in uncertain cases.

There may be also atresia at the lower part of a uterus, or of part of a malformed uterus, with a collection of menstrual blood in the cavity (hematometra), as shown in Figs. 1057 and 1058.

Rudimentary Horn.—The uterine malformation of most practical interest is that of a rudimentary horn with an otherwise nearly normal uterus. This is not so very infrequent and many are the diagnostic difficulties that result therefrom. Such a rudimentary horn extends outward from the main body of the uterus, and receives at its outer extremity the attachment of the fallopian tube and round ligament of that side. The point of attachment of the round ligament is, in some cases, the only decisive gross evidence as to whether the mass in question is an enlarged fallopian tube or a rudimentary horn of the uterus. The cavity of the rudimentary horn may be complete, extending

all the way from the fallopian tube to the main cavity of the uterus, or it may be only partial, being absent at some part, or the cavity may be entirely absent, the horn existing merely as a musculofibrous cord connecting the fallopian tube and round ligament with the uterus. Most of the trouble resulting from a rudimentary horn comes from infection in it or pregnancy in it (Fig. 1059).

The **symptoms** and **differential diagnosis** and **treatment** are the same as for similar affections of the fallopian tube, with the following special points:

1. The mass is usually connected to the uterus by a much broader attachment.

2. There is more enlargement of the uterus and distortion of its cavity.

3. The mass may become much larger without rupture if pregnant or without adhesions if inflammatory.
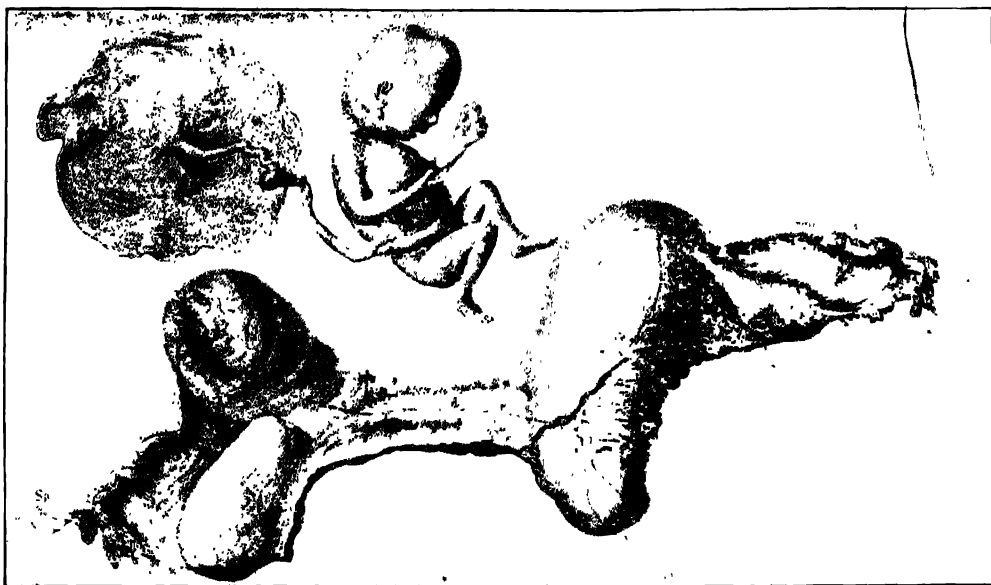
Fig. 1059.—Pregnancy in a rudimentary horn of the uterus. As there is no communicating cavity between the uterine cavity and site of the pregnancy in the rudimentary horn, the spermatozoa evidently came by way of the opposite tube, as indicated by the small arrows. (Kelly—*Operative Gynecology.*)

4. There may be a communication with the main uterine cavity. In most cases the condition is not thought of until found during the course of an operation for what was supposed to be some one of the more common affections. Even when thought of, a diagnosis is rarely possible (except in an examination under anesthesia), for it produces the symptoms and signs of more common conditions, and the trouble is naturally supposed to be some one of these more common affections. In some cases, however, there are anomalous symptoms or signs that make diagnosis difficult and doubtful, and arouse suspicion of this malformation. Sometimes there is decided resemblance to a fibroid. The senior author recalls one such case. The symptoms and signs were anomalous and puzzling. He made a diagnosis of probable fibroid with complications. Operation revealed a rudimentary uterine horn, with the remains of an early pregnancy in it. There was no fibroid.

Pseudohermaphroditism

A true **hermaphrodite** is, according to Ahlfeld's definition, "an individual with functionating active glands of both sexes, provided with excretory ducts." No such case has been reported in which the diagnosis has been fully accepted, though there is considerable dispute among authorities concerning some. Several cases have been recorded in which, among other anomalies, there were glands that on microscopic examination presented some of the characteristics of both ovary and testicle. But that condition does not constitute a double set of glands and excretory ducts.
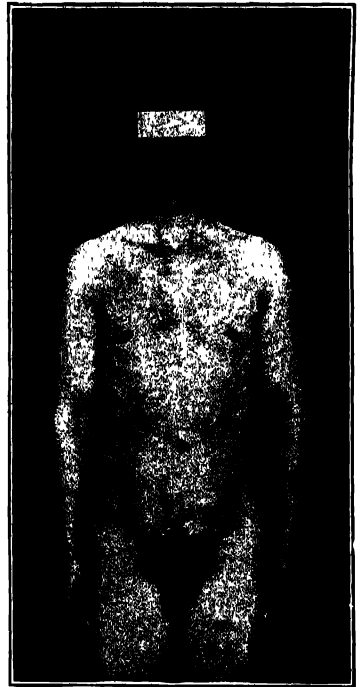
Fig. 1060   Fig. 1061.   Fig. 1062.

Figs. 1060 to 1062.—A pseudohermaphrodite. Fig. 1060, As the patient appeared on coming to the author's office for examination. Fig. 1061, Back view, showing the male type of body. Notice the broad shoulders and narrow pelvis. Fig. 1062, Front view, showing the male type of breasts. Notice that the upper limit of the pubic hair is horizontal, as in the female. Otherwise the external genitals present the typical appearance of hypospadias in the male. The divided scrotum and contained testicles hang down almost as in the normal male, though the rudimentary penis is hidden.

A **pseudohermaphrodite** is an individual of one sex presenting some of the local characteristics of the other sex. Many such cases have been recorded and not a few of them have presented a most difficult problem in regard to the diagnosis of sex. Neugebauer was able to collect 942 cases of pseudohermaphroditism. In at least 41 of the pseudohermaphrodites the true sex was positively determined only after abdominal section, though in only four cases was the operation undertaken specifically for diagnostic purposes. Numerous cases are recorded in which the individual dressed and lived for many years as a man or as a woman, and then ascertained that the real sex was the opposite one. The most celebrated case, perhaps, is that of Carl Hohmann, a masculine pseudohermaphrodite, who from infancy to the age of forty-six years

was considered a female and lived as such. The true sex being then ascertained, he assumed male attire and married as a man. The space available is not sufficient to permit the subject of pseudohermaphroditism to be taken up in an extended way. It is sufficient to mention some of the more practical points.

When a child presents any anomaly of the genital organs, a most careful examination should be made and all the possibilities considered, in order to determine positively the real sex. Figs. 1060 to 1064 show a case in which a mistake in diagnosis of sex was made in infancy, and the individual who was really a male dressed and lived as a woman for forty years. Steps in the development of the external genitals are shown in Fig. 1037. Most of the pseudohermaphrodites are really males (have testicles in the abdomen or scrotum), the resemblance to the female external genitals being due to some form

Fig. 1063.   Fig. 1064.

Figs. 1063 and 1064.—External genitals of the individual in Fig. 1060. Fig. 1063, Showing the general appearance—the divided scrotum and contained testicles, the rudimentary penis and the urogenital vestibule. Fig. 1064, The urogenital vestibule has been spread open, a uterine sound has been introduced into the urethra, and a forceps into the sinus pocularis.

The condition here is one of male hypospadias (as will be seen by referring to the explanatory drawings in Figs. 1065 and 1066) and yet this individual had dressed and lived as a woman for forty years.

of hypospadias accompanied with an abnormal opening or pocket that is mistaken for a vagina (Figs. 1065, 1066). The principal anomaly in female pseudohermaphrodites, that causes some resemblance to the male sexual organs, is hypertrophy of the clitoris, accompanied with adhesions of the labia minora or labia majora over the vaginal opening, or with imperforate hymen (Fig. 995), or with labial hernia, or hydrocele or other labial swelling covering the vestibule.

In some cases the positive determination of the sex is very difficult and may even be impossible except by abdominal section. The general rule in cases of doubt is to class the pseudohermaphrodite as a male until unmistakable evidence

of the opposite sex appears. This will avoid a mistake in a great majority of instances. In the case of four supposed female pseudohermaphrodites who were subjected to abdominal section, three of them proved to be males.

There are exceptional cases in which the sexual instincts of a patient do not correspond to the predominating type of sex organs present. Such a case presents a difficult problem in sex classification, and its solution can probably be best elucidated by detailing the handling of such a case. The patient came under the care of the senior author and the following quoted details are from his report of the case (see Reference List).
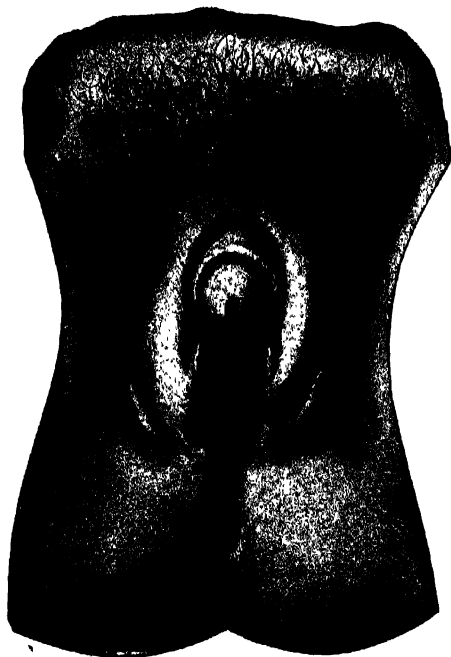
Fig. 1065.   Fig. 1066.

Fig. 1065.—Male pseudohermaphroditism. The appearance of the external genitals in marked hypospadias.

Fig. 1066.—A section explanatory of Fig. 1065. B, Bladder; R, rectum; P, penis with lower urethral wall absent; H, abnormal condition constituting hypospadias and requiring a careful examination to determine the sex of the child; X, sinus pocularis, enlarged and opening on perineum, and likely to be mistaken in the newborn for a vagina.

Malformations of the genital organs seldom impose any serious obstacle to the funda-mental sex classification of the individual. In some cases abdominal operation is necessary to give definite information concerning the internal organs, but this usually clears the matter promptly. Even in the cases of mixed sex gland, that is, where one individual carries both ovarian tissue and testicular tissue, the sex determination is not difficult. All that is required is to preserve the gland tissue corresponding to the patient's preferences and instincts, and remove the other type. Occasionally, however, a case is encountered which is not covered by our usual methods of sex recognition and requires a much deeper consideration of what constitutes the real sex of an individual and how this primary sex may be modified or partly obscured by later pathologic developments. Such was the prob-lem presented by the following case:

About the first of September, 1938, a young woman was sent to me for construction of a vagina. (Fig. 1067 shows the patient as she came for consultation.) She was twenty-eight years of age, and had never menstruated, though there had been some irregular bleed-ing when she was about twenty and again two years ago. On examination, I found the

genital organs identical with those of a male pseudohermaphrodite. (The conditions are shown diagrammatically in Figs. 1065 and 1066.) There was the small hypospadiac penis, and back of that a vestibule with two openings, the one in front being the urethra, and the one a little farther back, an enlarged sinus pocularis. The testicles were in the groins.

The general build was masculine, with narrow hips compared to the shoulders (Fig. 1068). There was marked hair growth, with masculine distribution. Also, the patient had a beard which required regular shaving. There was more breast tissue than is ordinarily found in the male (Fig. 1069). The left testicle was lower in the groin than the right, extending down into the upper part of the left labium majus (Fig. 1070).

When such conditions are present, the individual's inclinations and sexual desires ordinarily correspond with the male gonads, and in that case the classification as a male is correct. But in this case, the patient's instincts and preferences from childhood up, and the sexual desires and mental outlook of the present, were all strongly feminine.

Fig. 1067.—Another pseudohermaphrodite, as the patient appeared for examination.

This apparent sexual paradox made it necessary to determine if ovaries were present. Abdominal exploration was then carried out. This showed that there were no ovaries nor tubes nor uterus, the space between the bladder and rectum being entirely clear. With this operative revelation of no ovaries, the patient's earlier history became of special interest. During childhood there had been no departure from the ordinary activities of a girl. She went to the country school, got along very well with her studies, and associated with the other girls in their games. When not in school, she worked on the farm with the other children, doing her share of the heavy work. She always dressed and played as a girl. There were no tomboy inclinations, nor desire for boys' clothes nor amusements.

Pubic hair appeared at about fifteen years of age, but there was no menstruation. Sex desire towards men was noticed at age of eighteen or twenty. At about twenty, she had a slight pinkish discharge for three or four days. This was repeated four or five times, at intervals, she thinks, of about a month.
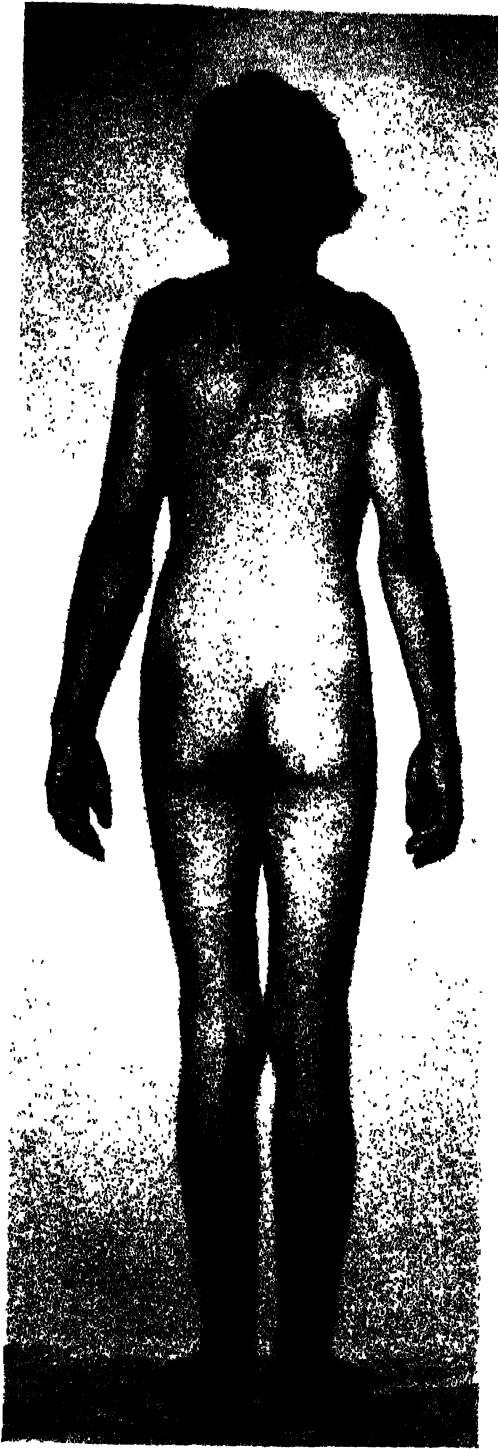
Fig. 1068.   Fig. 1069.

Fig. 1068.—Showing the male type of body form, with broad shoulders and narrow hips
Fig. 1069.—There was more breast tissue than in the male.

There was no more bloody discharge until about two years ago, when sexual inter-course began. Immediately after the first coitus there was a very free bloody discharge, which stopped the next day. Two weeks later there was profuse flow for some days, and five weeks later another short flow, but not so free. The last two flows came spontaneously, without coitus. Since that time coitus has taken place frequently, without any bleeding or pain or other disturbance, except that the vagina is very short. Her sexual desires have always been toward men, never shifting to women.

Fig. 1070.—The external genitals, showing marked hair growth, a testicle in the left labium majus, an enlarged clitoris and the perineal opening leading into a short vagina (or an enlarged sinus pocularis).

Here, then, was a patient with strong feminine instincts, sexual desires, and general outlook on life, but with testicles and no ovary. What sex classification should be made of such an individual? That was the important and difficult problem which had to be worked out before anything could be done in the way of constructive surgery for the patient, because the type of surgical help required depended on whether the individual was to live as a man or as a woman.

If I followed the gonads and classified the patient as a male, I was directly opposed by the whole record of the individual's instincts, sexual desires and response, and the outlook into the future. If I followed the latter and classified the patient as a female, there was no ovarian tissue on which to rest the decision. A female with testicles and no ovary seemed paradoxical, and of doubtful authenticity. Still the patient had to be classified one way or the other. There was no neutral ground.

What are the dependable criteria for determining the primary sex of an individual? Of course, in this endocrine age, the gonads and their hormones occupy the center of the stage and are looked upon as the decisive factors in the sexual field. But are they? Such a case as this casts serious doubt on their fundamental importance in determining the primary sex personality. The gonad with its hormones may be an effect instead of a cause, as far as primary sex is concerned. Their influences are easily seen and may seem all-important, but there are other influences which enter into the building up of the instincts and directing forces. There is the whole nervous and mental system, which is as important a part of the individual as the gonads, and probably comes from just as strong genetic factors.

Wolf, of the University of Bern, holds that in the chromosomal arrangement and determination of primary sex an impress is made on the somatic cells which takes precedence over that on the gonadal elements, which develop later. In discussing such cases, he states that the somatic and psychic impress seems predominant and that, though hormones play a role in later structural developments, the sex of the somatic cells is decisive. Novak, in discussing his case mentioned later, states, ''Such patients as I have described represent genetic females, in which gonadal reversal took place at a very early phase of development, with complete replacement of ovarian by testicular elements.''

Reviewing then the two sets of phenomena which help in primary sex classification, we have in this case a personality with well-developed female instincts, preferences, sexual desires, and mental outlook, and on the other hand rudimentary male gonads and associated secondary developments. The testicles undoubtedly lack spermatozoa formation, and hence have stopped short of full development. The spermatic cords and prostate are still more rudimentary, being hardly appreciable in the abdominal exploration. The phallus is rudimentary, and resembles an hypertrophied clitoris as much as a hypospadiac penis. The canal in the perineum, which admits a finger for about an inch, may as well be considered a small vagina as an enlarged sinus pocularis. In such a case, of good development of instincts and mental make-up and poor development of physical structures, it seemed to me that the individual should be classed on the side of the well-developed set of phenomena. Hence, I felt that the patient should be considered as primarily and essentially a female, and that our advice and treatment should be directed accordingly.

Now, could any substantial support be found for thus classifying and treating as a female, a patient with testicles and no ovary? The decision was a serious matter, for on it rested the direction of the future life-activities of the individual. Also, the decision had to be made promptly, as the patient was recovering from the abdominal exploration and was about ready for the further surgical work required.

In the short time available, I found records of seven comparable cases, that is, of cases in which predominant female sex desires and preferences persisted in the presence of testicles without an ovary. Of course, there are many other reported cases of this type, but these seven cases had been handled in recent years, under the present fund of knowledge concerning endocrines and sex determination, and hence their handling was studied with particular interest.

In these seven cases, the absence of ovaries was confirmed by abdominal exploration in five, and seemed fairly certain in the other two. The testicles were removed in six cases, and in the other case they were shifted from the groin to inside the pelvis. The hypertrophied clitoris was removed in four cases. In all of the patients operation was followed by improved social and sexual adjustment and continuation of normal libido. The essential details of these reported cases applying to our problem, were briefly as follows:

Mishell (Case 1): Patient, aged 35, was of feminine build, but had never menstruated. She came for treatment for tender lumps in the groins. Examination showed double

inguinal hernia with a testicle in each. External genitals were normal, with vagina represented by a small canal three inches long ending bluntly with no cervix.

Abdominal exploration showed no ovaries, tubes or uterus. The testicles were removed, and the hernias repaired. Improved adjustment. Patient returned to her work. Normal libido.

Mishell (Case 2): Sister of preceding patient, aged 23, feminine build, complained of tender lumps in groins. Abdominal exploration showed no ovaries, tubes, or uterus. Testicles were removed. Improved adjustment and patient continued with good health. Headache which had troubled her disappeared after the operation.

Mishell (Case 3): Sister of the preceding, aged 32, had lumps in the groins and had never menstruated. Examination showed the same conditions in this sister as in the other two. Feminine build, good breasts, no hirsutism, and instincts and feelings all feminine. The only thing special was that she became gray in childhood at the age of nine. The patient was well-adjusted, emotionally stable, had no complaint, and no operation was required. This was one of the two cases in which the absence of ovaries was not confirmed by abdominal operation, but careful pelvic palpation along with the similarity to the other two sisters excluded ovaries with fair certainty.

Rubovitz: Patient, aged 39, masculine build, beard, testicles in groins, hypertrophied clitoris, short vagina, came complaining of severe libido and painful erections. The testes and the hypertrophied clitoris were removed, and the short vagina lengthened. There was improved adjustment and normal libido. The relief from the annoying erections was probably due more to removal of the enlarged and hypersensitive clitoris than to removal of the testicles, for as pointed out later the removal of the testicles seems to exert no influence on the sexual desires and responses of these patients. This is the other case in which the absence of ovaries was not confirmed by abdominal operation. But by deep palpation and the use of pneumoperitoneum, it was felt that ovaries were excluded with fair certainty.

Wharton: Patient, aged 18, was of masculine build from the waist up and feminine build from the waist down. Had a beard. There were bilateral inguinal hernia, hypertrophied clitoris and short vagina. On this diagnosis, the troublesome hypertrophied clitoris was removed and the hernia operation begun. In the hernial sac a testicle was found. An incision on the other side showed another testicle. The incisions were then closed, and later it was explained to the patient that a serious mistake had been made in amputating the supposed enlarged clitoris, which was in fact a penis, and that she was not a female but a male with two testicles. But the patient took quite a different view of the situation. She stated that no mistake had been made in amputating the enlarged clitoris, that she knew she was a woman and that she intended to live as such, and insisted on removal of the testicles. The testicles were finally removed, and abdominal exploration showed no ovaries. Improved adjustment. Normal libido. The patient married and sexual intercourse was satisfactory on her part and also on the part of the husband, except that the vagina was short. It was lengthened later.

Young: Patient, aged 21, masculine build, but no beard. Lumps in the groin, no vagina. Patient was engaged to marry. Abdominal exploration showed no ovaries, tubes, or uterus. A vagina was constructed and the inguinal testes were put back in the pelvis instead of being removed. Improved adjustment. Normal libido.

Novak: Patient, aged 19, masculine build, beard, hypertrophied clitoris, short vagina. In this case pelvic palpation showed bodies in the position of the ovaries, and about that size. Abdominal operation showed these bodies to be testicles in the usual position of ovaries and with a rudimentary broad ligament, but no ovaries, tubes, or uterus. The abdominal testes and the hypertrophied clitoris were removed. Improved adjustment. Normal libido. The vagina is to be lengthened later.

Our Case (for comparison). Patient, aged 28, masculine build, beard, testicles in the groins, short vagina. Came for construction of vagina. Abdominal exploration showed no ovaries, tubes, or uterus.

It was clear then that those who had already struggled with the problem of the cases of this type had reached the same conclusion I had, namely, that the patient should be treated as a female. Some had reached this conclusion in the primary study of their pa-

tient, and others had been forced to it by later developments which confirmed and emphasized the predominance of the female element in the personality.

Having classified the patient as a female, with the right to live as such, the next step was to plan treatment to help as much as possible in that direction. The patient's two complaints were: first, the hair on the face which required frequent shaving and, second, the smallness of the vagina. So the two problems were to lessen the facial hair, by lessening the masculinity, and to lengthen the vagina. To accomplish these things, a combination treatment was planned consisting of (a) removal of the testicles, (b) administration of estrin preparations, and (c) stretching treatments for the short vagina.

Accordingly, I removed the testicles, doing the work under local anesthesia and checking each one with frozen section examination before removal, to exclude herniated ovary or ovotestis from removal. Later, Dr. Hobbs, in charge of the Laboratory, made a careful microscopic study of the testicles and there was no indication of ovarian tissue anywhere. As usual with retained testicles, there was no spermatozoa formation. At the preceding abdominal exploration, Dr. Sanford made a critical palpation of the kidney areas and could find no indication of adrenal tumor.

Systematic stretching treatments for the vagina are being employed. If sufficient lengthening cannot be secured in that way then operation is to be carried out. Estrin administration is being pushed with the double purpose of lessening the facial hair, by diminishing the masculinity, and of aiding the vaginal stretching by softening the pelvic tissues.

Various details discussed must be omitted here for lack of space, but it may be stated that in this case and in the reported cases the absence of ovaries and the presence of testicles seemed to exert little or no influence on the strong female desires and responses. Despite the hindering presence of testes and later the lack of sex glands altogether, the patient's feminine personality continued the even tenor of its way.

An important point in taking care of such a patient is to avoid terms or expressions which may disturb her psychologic balance by making her uncertain as to her sex. All records and explanations and reports should be made to conform to the correct primary sex, as worked out by careful study of the case. The patient is already disturbed by the malformation which she wishes corrected, but as a rule she has no thought that she may not be a woman, and it is strongly inadvisable to put her further adrift on the sea of uncertainty by branding her as a male according to the old superficial structural classification.

This patient married about a year later, and a recent report states they "are getting along fine."

MENSTRUAL DISTURBANCES

In taking up disturbances of function in this and the succeeding two chapters, we shall consider not only those disturbances which are designated as "functional" because no organic lesion is apparent, but also the disturbances of function due to various organic diseases- ·that is, all "disturbances of function," whether or not accompanied by evident organic disease. These conditions are, of course, only symptoms. They are not diseases and must not be taken to constitute a diagnosis. They are only indications of some disease, and the physician must determine the nature of that disease by further investigation.

In these three chapters the disturbances of function will be taken up in the following order:

> Menstrual Disturbances
> Sterility and Sexual Disturbances
> Miscellaneous Disturbances (including those of the Climacteric)

MENSTRUAL DISTURBANCES

In considering disturbances of menstruation we shall take them up in order as follows:

> Menorrhagia, Metrorrhagia, Irregular Menstruation, Precocious Menstruation, and Vicarious Menstruation.
> Amenorrhea, Scanty Menstruation, and Suppression of Menstruation.
> Painful Menstruation (Dysmenorrhea), Intermenstrual Pain.

MENORRHAGIA AND METRORRHAGIA

When a patient complains of uterine bleeding, it is often a question at first whether the bloody discharge is excessive menstruation or bleeding from some other cause. A considerable period of investigation and treatment may be needed to determine this point. The pelvic examination may not settle it, for even if no palpable lesion is found there may still be a small submucous myoma or other nonpalpable lesion. Consequently, in the diagnosis and treatment of these cases in the office and at the bedside, the start is made with the combined groups represented by the bleeding patient.

In taking care of such a patient, naturally treatment is given to stop the blood loss while investigating its cause. The response to treatment aids some-

what in further differential diagnosis, and in determining what additional therapeutic measures are required. It is apparent, then, that the practical handling of these patients comprises a treatment-investigation program which checks the blood loss and, step by step, differentiates the underlying cause so that curative measures may be instituted.

TREATMENT-INVESTIGATION PROGRAM

The first interview and examination will identify those patients with an obvious lesion sufficient to account for the bleeding. The treatment for such lesions will be found in the appropriate chapters. For handling patients with no obvious lesion, it is convenient to group them into classes representing different age-periods, as follows: 1. Infancy and childhood (ages one to ten). 2. Developmental period (ten to twenty). 3. Childbearing period (twenty to forty-five). 4. Involutional period (forty-five to sixty). 5. Senile period (beyond sixty).

Infancy and Childhood (Ages One to Ten)

The principal causes of bleeding in this age-period are endocrine disturbance from withdrawal of maternal estrin at birth, ovarian tumors exerting an endocrine influence (granulosa-cell tumors), pituitary or adrenal or pineal tumor, and rarely malignant growth in the vagina or ovary or uterus. Bleeding at birth or a few days thereafter, not due to birth injury, is caused by withdrawal of the maternal estrogenic hormone which the fetus has been receiving. This show of blood is of no clinical importance and requires no treatment.

From the general examination one can tell if the child belongs in the endocrine group of cases found in adrenal, ovarian, pituitary, and pineal tumors. The differential diagnostic points are given in Chapter II, and suggestions for the examination will be found under the details for the next age-period.

The treatment consists of general supportive measures while the underlying cause is being investigated. After the cause of the bleeding in that case is determined, treatment is given for that particular disease as outlined in the appropriate chapter. Vaginal bleeding in young girls which cannot be accounted for by some general blood dyscrasia or other evident lesion calls for a thorough investigation, because a pelvic tumor is the cause of the bleeding in a large proportion of the cases of this age-group. This investigation should include, when necessary, pelvic examination under anesthesia and curettage, with microscopic diagnosis of the tissue removed.

Developmental Period (Ten to Twenty)

This is the developmental age as far as the functions of the genital tract are concerned. The causes of bleeding in this age-period are endocrine disturbances, blood dyscrasias, inflammatory lesions, pregnancy complications, ovarian tumors, uterine myomas, and malignant disease—the relative frequency of occurrence being about in the order given.

The first step in the investigation-treatment program in these cases is to obtain in the history an accurate record of certain items of special importance in the differentiation, as follows:

History items of special importance.
  a. Menses—age of onset, regularity, duration, amount.
  b. Weight—loss or gain, with time involved.
  c. Hair—texture, distribution, premature graying, or undue falling out.
  d. Headaches—location, type, duration.
  e. Vision—glasses necessary, or other disturbance.
  f. Gastrointestinal symptoms.
  g. Nervous symptoms—irritability, depression, crying spells.
  h. General symptoms—Does patient tire easily? Is she sleepy most of the time? What are her habits of sleep, exercise, work about the home, study, recreation at home, vacation activities?

Examination items of special importance.
  a. Type of build—measurements symphysis to floor, symphysis to crown, span from finger tips to finger tips.
  b. Secondary sex characteristics—hair distribution and texture, breast development, vulvar hair growth and development of parts (labia, clitoris).
  c. Lean or fat. If fat, note distribution.
  d. Blood pressure and pulse.
  e. Findings in the abdominal, rectal, and rectoabdominal palpation.

Having obtained the items of information and recorded them for study, the physician is in a position to begin recognition of the general type of disturbance, which recognition will indicate the next step in the diagnostic-therapeutic program. The general groups to be considered in these bleeding patients of the developmental age, are (1) the blood dyscrasia cases, (2) the general disease groups, (3) the pelvic lesion groups, and (4) the endocrine cases.

1. Blood Dyscrasia Group. Uterine bleeding may be due to the condition of the blood without any local disease. It is surprising over how long a period patients will be given endocrine and other treatment before having a blood examination, which reveals the serious disease back of the symptomatic uterine bleeding. To mention this is sufficient to call attention to the importance of prompt investigation of the blood condition in bleeding cases, so that any serious disorder in the blood-making organs will be discovered early.

2. General Disease Group. Other serious general diseases, such as pulmonary, gastrointestinal, kidney, and cardiovascular, are to be eliminated, and in this age-group it is ordinarily advisable to make that elimination before subjecting the patient to vaginal examination.

3. Pelvic Lesion Group. The patient may have a uterine myoma or an ovarian cyst or one of the special tumors with endocrine influence (granulosa-cell tumor) or one of the rare malignant tumors of adolescence (teratoma, sarcoma). Any one of these conditions may cause sufficient disturbance to result in a bloody discharge.

Some differentiation information in this direction has been secured in the general examination, which in these patients should include careful abdominal palpation and rectal and rectoabdominal palpation. The latter will show if there is any mass of considerable size in the pelvic interior or any area with undue tenderness.

4. Endocrine Group. If there is no evidence placing the patient in one of the three groups above mentioned, we assume for the time being that she belongs to the endocrine group, and proceed accordingly.

Endocrine Cases.—The quantitative blood and urine tests for ovarian and pituitary hormones are still not decisive enough to be of practical value in directing therapy. The determinations which will probably eventually be helpful are the pregnanediol test for progestin, quantitative test for the various estrogens, especially estriol, and quantitative tests for pituitary A and B.

From a clinical standpoint the premenstrual endometrial biopsy is still the most accurate index of ovarian function. Recent studies indicate that not only can ovulation be determined, but also deficiency of the corpus luteum function is indicated by an incomplete premenstrual picture.

With functional bleeding all patterns are found, from a normal premenstrual endometrium to an anovulatory type of interval or hyperplastic endometrium. The majority of the cases with functional bleeding show an anovulatory type of endometrium or one in which the premenstrual changes are poorly defined, indicating that ovulation has occurred but that the resulting corpus luteum is defective or deficient in its output of progestin.

At present we are interested in what can be done for the bleeding patient with the knowledge we now possess.

Treatment.—Before starting on specific types of therapy it is well to mention several **general principles** controlling the order in which treatment methods should be used.

1. First in importance is the amount of flow. If this is excessive and the blood loss is marked, curettage will be the first step. After the bleeding is controlled then investigation may be carried out to determine treatment. (Fatal menstrual hemorrhage has been reported in young girls.)

2. The age of the patient is important. For instance, we prefer conservative treatment in young women, whereas in women over forty-five radiation may be the method of choice.

3. The economic status of the patient will arbitrarily limit the therapy to medicine which the patient is able to afford.

The **order of treatment** then in young girls and women in childbearing age will be about as follows, with variations as dictated by the above-mentioned conditions:

1. Regulation of *diet* as needed, with special attention to an adequate supply of vitamins. Vitamin C was found by Junghans to control capillary hemorrhage.

He treated 35 women suffering from menorrhagia with vitamin C, using 50 mg. doses intramuscularly twice daily. In 33 of these women the bleeding stopped in four to six days. He found this treatment valuable also in thrombopenic cases with uterine bleeding. Vitamin K has proved helpful in controlling bleeding in jaundiced cases and in hemorrhage in the newborn, and may later be found to be successful in other conditions. Calcium is necessary in the blood-clotting mechanism. It is supplied in milk, cheese, and dairy products. A high protein diet, with oral fibrogen or arrhenopectin, is used if the clotting time is found to be abnormally prolonged. Foods high in iron are needed to help replace that lost, and if enough cannot be taken in the diet additional iron should be given (as ferrous iron).

2. *Thyroid* therapy should be given when the basal metabolism indicates a need for it. The basal rate is not always accurate as a guide to therapy, but usually a grain of standard thyroid for a minus 10 of the basal rate will be adequate. If symptoms persist, the dose may be increased cautiously, using the patient's feelings and the pulse as a guide.

3. In atonic individuals the bleeding may be due to a lack of uterine tone, and these are the cases most frequently helped by *ergotrate*. The firm contraction of the uterus, by compressing the deeper circulation, diminishes the volume of blood flow through the uterus and thus the amount of blood loss.

4. *Snake Venom* has been used successfully in the treatment of functional bleeding by Goldberger and Peck.

They reported relief in 17 of 20 women treated, and state that the expense of therapy is considerably less than it is with hormone therapy. The venom has a direct effect on the walls of the small blood vessels, making them more resistant to bleeding. The improvement in these cases extended from 2 months to 4 years.

Method.—Moccasin venom in 1:3,000 dilution (prepared by the Lederle Laboratories) is used. Daily doses are given subcutaneously, starting with ½ c.c. and increasing to 1 c.c. by the third dose. If the bleeding is very profuse, 1 c.c. is given twice daily until the bleeding is controlled, then two to three times a week for three menstrual periods.

As much treatment as possible should be given during the first ten days, for patients develop a sensitization to the venom and must be desensitized before continuing therapy. Peck has been able to separate the antigen of the venom from the factor active in controlling bleeding so that the undesirable sensitization action is eliminated.

5. *Hormone Therapy.* Of the hormones used there are three main groups from which to choose.

A. Chorionic Gonadotropins, from pregnancy urine or pregnant mare's serum.

B. Anterior Lobe Extracts.

C. Sex Sterols—estrogens, progestin, androgens.

These will be discussed in the order named:

A. Chorionic Gonadotropins.— a. Pregnancy urine– antuitrin-S, follutein, korotrin, etc. The action of these hormones on the control of bleeding is still not clear. It was formerly thought to cause luteinization and ovulation but this has been disproved in the human by Hamblen and Geist and others. It is probable that the effect is due to a direct action on the uterine muscle or to an indirect one through destruction of persistent ovarian follicles. Good results have been reported by a number of men.

Method.—100 U. daily till bleeding is controlled, then 100 U. every other day, starting seven days prior to the expected flow. This is continued through several cycles, and then the treatment is discontinued to determine if the patient needs more therapy to control the flow. If so, it is given as needed.

b. Pregnant Mare's Serum—gonadogen, gonadin, anteron, etc. This preparation offers real hope of correcting the underlying cause in the anovulatory type of bleeding.

Davis and Koff were able to cause ovulation in normally ovulating women at any desired time in the cycle, though they were not able to duplicate this in women having nonovulatory cycles. There is considerable disagreement among workers at the present time as to the ability of this preparation to cause ovulation in nonovulatory cases, but its success in some proved cases of nonovulatory sterility suggests that it does cause ovulation in some cases.

Method.—Davis and Koff recommend intravenous administration. But many workers are now using 10 to 20 units of gonadogen intramuscularly daily from the fifth to the twelfth day, and then giving one intravenous dose of 20 to 40 units as the last dose. Treatment should be tried for several cycles and then a rest period given, so as to prevent the development of antihormones. The patient should always be tested for sensitivity to horse serum before giving pregnant mare's serum.

B. Anterior Lobe Extracts—prephysin, gynatrin, etc. Hisaw and Fevold used this preparation experimentally and found that it contained follicle-stimulating hormone. L. H. Sevringhaus has reported excellent clinical results in menorrhagia, and other endocrine disturbances.

Method.—The cyclic therapy is used the same as with the pregnant mare's serum, but it is not given as a rule intravenously. The dose is 50-100 units daily from the fifth to the twelfth day.

Mazer and Ravetz have reported excellent results in 14 out of a group of 18 cases of functional bleeding, using a combination of chorionic gonadotropin from human pregnancy urine and an extract from the anterior lobe of the pituitary. The latter seems to contain a synergist necessary for the action of the luteinizing hormone of pregnancy urine. This product will soon be available under the trade name of synapoidin (Parke, Davis).

C. Sex Sterols—(a) estrogens (estrone, estradiol, estriol, and the benzoated compounds, also stilbestrol), and (b) progestin (progesterone, pregneninonol or pranone). These two hormones are considered together, for it is by the combination of both, used in cyclic therapy, that control of bleeding is obtained.

Hamblen found that bleeding in anovulatory patients could be stopped in three days by daily doses of 10,000 to 20,000 I.U. of estrogen. On cessation of treatment, however, the bleeding would recur in three to ten days. Progestin given in the early phase of the cycle frequently caused the patient to start to bleed, and, if given during the menses it usually increased the flow.

When estrogen and progestin were used in the time relations as they act in a normal cycle Hamblen, in a series of 12 patients, obtained 45 normal cycles out of 46, and most of these patients continued for months with normal cycles after the treatment was stopped. Hamblen also obtained good results using estradiol, estriol, and pranone by mouth, but at present the dosages required make the expense of this treatment prohibitive.

Method.—The following cyclic therapy is used by Hamblen. First a cessation of bleeding is secured either by curettage or estrogen therapy as mentioned above. Starting one week after the cessation of the bleeding the patient receives 10,000 to 20,000 I.U. of estrogen daily for fourteen days, following which she is given 5 I.U. of progesterone daily for seven days or until the bleeding starts.

A less expensive oral therapy is now being tried at several medical centers using stilbestrol, but as yet it is too early to evaluate this work. Progestin alone, 5 mg. daily for several days before the period, is adequate in some cases of functional bleeding.

c. Male Sex Hormone or Androgens—testosterone propionate. The action of this hormone in controlling bleeding is thought by some to be an indirect one through the inhibition of the pituitary, while others, notably Sturges and Abarbanel, feel that the action is a direct one on the uterine muscle and on the muscle fibers constricting the coiled arterioles. The general action on the muscle inhibits rhythmic (estrin) contractions, thereby decreasing the volume of blood flowing to and through the uterus, and the local action stimulates the myometrial elements about the arterioles constricting them and thus helping to control the blood loss.

Method.—An initial dose of 10 to 25 mg. is given intramuscularly, and then the same dose is given subcutaneously for three or four days. The bleeding usually increases twenty-four hours before it stops.

Subsequent therapy depends upon the type of endometrium found. If premenstrual changes are present, then 10 to 30 mg. are given subcutaneously in divided doses over seven to ten days prior to the expected period. If a proliferative or hyperplastic endometrium is found, 50 to 100 mg. subcutaneously in divided doses are given over two to three weeks

preceding the period. Greenhill gives 25 to 50 mg. every other day in cases of severe bleeding, until it is controlled. Geist found that by mouth it was necessary to give 300 to 1,000 mg. male hormone to be effective.

There are reports in the literature of undesirable effects, such as hair growth on the lip, enlargement of the clitoris, deepening of the voice and other masculinizing effects, from the use of the androgens. Abarbanel found no masculinization in over 200 cases treated with the androgens.

6. *Curettage,* repeated as needed is a helpful therapeutic and diagnostic aid.

7. *Radiation.*—The cases treated by radiation are divided into two main groups (a) women past the childbearing period, in whom the purpose is to stop menstruation entirely, and (b) women in the childbearing age or young girls, in whom the purpose is to regulate the menstruation. In the latter group it is well to try endocrine treatment first before resorting to radiation, as the menses are occasionally stopped permanently even by small doses of radiation.

Method.—Pemberton in a series of 131 cases, 45 per cent under twenty years and the rest under forty years, obtained 78 per cent of cures using radium in doses of 200 to 500 mg. hr., most of the dosages being under 400 mg. hr. Keene and Payne secured excellent results, using dosages of 200 mg. hr. if under twenty years, 400 mg. hr. from twenty to thirty years, and 300 mg. hr. from thirty to forty years.

X-ray of the ovaries, and in some cases the pituitary, thyroid, and spleen, has been reported by a number of workers. Drips claims cures in 3 out of 4; Mazer, 35 of 44; Molinari and Vierhiller, 21 of 46; Kaplan, excellent results.

Radiation of an endocrine gland of such vital importance to the body as a whole as is the anterior lobe of the pituitary, has always seemed to us a rather risky thing to do. Hence we feel that x-ray of the pituitary should be reserved for cases which do not respond to other forms of therapy.

8. *Operation.*—In young women with bleeding severe enough to damage their health, hysterectomy is sometimes necessary. Repeated curettements, however, plus endocrine therapy should be used before resorting to this radical procedure.

Childbearing Period (Twenty to Forty-Five)

In this age-period bleeding is caused by conditions associated with pregnancy, inflammations in the pelvis, myomas, ovarian cysts, endocrine disturbances, blood dyscrasias, and pelvic malignancies. The relative frequency of these conditions in the childbearing period is about in the order here mentioned.

Pregnancy complications causing bleeding can all usually be determined by the history and examination. If there is still doubt, an Ashheim-Zondek test will ordinarily settle that point. Inflammatory lesions and the larger myomas and ovarian tumors are evident from the history and pelvic examination findings. In patients approaching the age of forty carcinoma of the uterus must always be considered, and if the bleeding does not respond promptly to treatment, there should be no delay in doing a therapeutic and diagnostic curettage.

In this period when the normal endocrine cycles have been fully established, the endocrine deviations are not so frequent as in the susceptible developmental period. Bleeding in the childbearing age is more likely to be due to some definite lesion in the genital tract or in some other system of the body. However, with the exclusion of lesions including pregnancy complications, endocrine dis-

turbance must be considered, and even with a lesion there may be associated endocrine factors. Consequently, this element must be kept in mind in all cases in which there is no other definite and sufficient cause for the bleeding. In the endocrine cases, a careful history will often show endocrine disturbances in the developmental period.

The treatment-investigation program for the handling of bleeding patients in the childbearing period is much the same as that for the developmental period, with certain obvious variations. Curettage may be employed more promptly for bleeding which tends to persist, taking care, however, not to curette for the irregular bleeding of tubal pregnancy and not to be deceived by the made-up story of the woman seeking a curettage for the purpose of abortion.

Involution Period (Forty-Five to Sixty)

In the bleeding cases of this age-group, pelvic malignancies come forward to the place of first importance. The malignancy may be in the form of carcinoma of the uterus or the ovaries. In regard to the uterus, carcinoma of the cervix is more frequent in the decade forty to fifty and carcinoma of the corpus in the decade fifty to sixty.

In this period of declining endocrine function, endocrine disturbances again become rather frequent, but serious ones leading to structural change are much less frequent than in the developmental period. Though granulosa cell tumors causing bleeding occasionally occur, most of the endocrine disturbances of this period are the minor nervous and circulatory discomforts constituting the common "menopause symptoms," which will be considered in Chapter XVI.

In the treatment of bleeding in the period of involution, curettage of the endometrium and conization of the cervix for chronic cervicitis are to be carried out promptly on account of the danger of carcinoma in those locations. If the microscopic examination of the curettings shows no malignancy, but only hyperplasia of the endometrium, the subsequent treatment differs somewhat according to the age of the patient. If still in the early forties with fairly regular menstruation, showing that ovulation is still going on, it is well to follow the curettage with hemostatic and endocrine treatment to control the bleeding tendency as in the childbearing period, so as to preserve the ovarian endocrine influence. If the patient is approaching the age of fifty, irradiation treatment (by radium or x-ray) should be given to stop the undue endometrial activity, as the persistence of it at that age may eventuate in endometrial carcinoma. The use of very large doses of estrogenic substances for the treatment of menopausal symptoms should be avoided after forty years of age.

Senile Period (Beyond Sixty)

Beyond sixty years of age, bleeding has about the same significance as it does in the latter part of the involution period. It is usually due to carcinoma of the endometrium or of the cervix uteri or of the ovaries. If no malignancy is found, the most probable cause is granulosa-cell tumor of the ovary. The bleeding here referred to is, of course, bleeding from the uterus. There may be some bloody vaginal discharge due to atrophic vaginitis or other simple inflammatory trouble, but that is easily recognized on the vaginal examination.

IRREGULAR MENSTRUATION

The menstrual flow may come too soon, the interval being only ten days or two weeks. Again the flow may not come soon enough, running overtime from one to two weeks. It is sometimes difficult to determine positively whether the irregular flow complained of is really menstruation or simply a bloody discharge from some disease of the vagina or uterus. Unless the bleeding resembles closely the menstrual flow in character and onset and duration, it should be regarded as a pathologic discharge, and an examination should be made to determine its cause, that proper treatment may be instituted.

PRECOCIOUS MENSTRUATION

Precocious menstruation is the appearance of menstruation at an early age. For genuine menstruation to take place, there must be considerable development of the genital organs, and this very rarely occurs before the age of ten, except in a patient with granulosa-cell tumor. A description of the clinical characteristics of these tumors with illustrative cases will be found in Chapter XII. Novak describes a constitutional type of precocious menstruation.

Great care is necessary, however, in establishing the fact of precocious menstruation in a given case. Every stain of blood does not mean menstruation. The blood may come from some inflamed or irritated area or ulcer, or growth on the vulva or in the vagina, uterus, rectum, or bladder. In infants a slight bloody uterine discharge occurs not infrequently within the first few days after birth, due to the withdrawal of the maternal estrin.

VICARIOUS MENSTRUATION

Vicarious menstruation is the discharge of blood from other parts of the body at the menstrual time. The uterine discharge may or may not be wholly or partially suppressed. The bleeding usually takes place from the nose or from some open sore, though it may come from almost any mucous surface, such as the lungs or stomach, or bladder, or rectum. Much more rarely some area of the cutaneous surface is affected, the axilla and the groin being the most frequent. At the affected site there appears an ecchymosis and later a distinct flow of bloody serum. The vicarious flow is likely to be irregular, appearing only at some menstrual periods. Allied closely to this is the monthly discharge of milk from the breasts sometimes observed.

Vicarious menstruation in any form is rare. Goffe records a very interesting case in which the vicarious discharge came alternately from the nose and the axilla, and seemed to be associated with periods of ungratified sexual desire. Vicarious menstruation is found principally in nervous women in whom there is imperfect development of the uterus or imperfect performance of its functions. The treatment consists in the correction of any pelvic disease present and endocrine treatment to regulate ovarian function.

Some of these cases of vicarious menstruation are probably due to metastatic bits of endometrial tissue which are transplants from a pelvic endometriosis.

ABSENCE OF MENSTRUATION (AMENORRHEA)

Amenorrhea is the absence of menstruation for one or more periods between puberty and menopause. This definition includes the absence of the menses during pregnancy and lactation. This is known as "physiologic amenorrhea."

Pregnancy must always be taken into consideration in a case of amenorrhea, and before the amenorrhea is attributed to any other cause, pregnancy must be excluded—by the circumstances of the case or by questioning the patient or by an examination.

Amenorrhea from other causes is found principally in girls and young women in whom the function of menstruation has not yet been completely established. The age of puberty, i.e., the beginning of menstruation—varies within normal limits considerably. Girls begin to menstruate, as a rule, at the age of twelve or thirteen or fourteen. The beginning of menstruation may be postponed until the age of sixteen or seventeen without disturbance. Usually, however, after the age of sixteen, and often before that, if the menstrual flow does not appear, there are disturbances that indicate some departure from normal health, and the patient may be said to have amenorrhea.

Amenorrhea is not a disease, but only a symptom. It may be an indication of any one of several entirely distinct conditions, just as a cough may be an indication of laryngitis or bronchitis, or pneumonia or tuberculosis. When a patient comes complaining that she does not menstruate, the first thing to do is to determine **why** she does not menstruate, i.e., what disease or condition lies back of this symptom.

In practice it is convenient, for purposes of diagnosis and treatment, to divide the cases of amenorrhea into two classes: one class (A) including those patients who have never menstruated, and the other class (B) including those who have.

A. WHEN THE PATIENT HAS NEVER MENSTRUATED

A mother brings her daughter, aged fifteen or sixteen or perhaps eighteen, to you, stating that the girl has never become unwell. The mother is anxious to know why the girl does not menstruate and, of course, what should be done for her.

There is a tendency on the part of physicians generally to treat this situation lightly and assure the mother that it is of no importance. The error of this advice is appreciated when, ten years later, the patient returns to know why she is unable to become pregnant and examination shows a very small, undeveloped uterus. If an investigation had been made when the mother first brought the girl to the doctor, the underlying cause of the amenorrhea might have been located and the uterus developed by proper treatment. After a uterus has remained small long past the normal time for development, the chance for improvement becomes much reduced.

When the patient has never menstruated, the absence of menstruation may be due (1) to some malformation, such as imperforate hymen or atresia of the vagina or imperfect development of the vagina, uterus, or ovaries, (2) to poor general health, usually with pronounced anemia, or (3) to endocrine dysfunction. The order given is the one preferable to use in the investigation-treatment program.

1. Malformation

Because of the possibility of there being some serious defect in the devel-opmental processes, examination of the pelvic structures is indicated early in the investigation.

Obstruction in the genital canal gives rise to no symptoms until puberty is reached. At the age of thirteen or fourteen or later the patient begins to feel ill each month. At intervals of about four weeks she notices marked lassitude and loss of appetite, feels somewhat feverish and out of sorts, has pain in various parts of the body, more particularly in the back and lower abdomen. She complains just as a woman does when she is about to menstruate. Her mother thinks menstruation is coming, but no flow appears. After a few days the pain and other disturbing symptoms subside and she feels fairly well until the next month. After several months the pain and accompanying disturbances last longer—in fact, may become almost continuous—and the patient's general health begins to suffer. A swelling may appear in the lower abdomen or at the vaginal entrance.

Such a history makes a local examination imperative. In the local examination, if the condition be imperforate hymen, the vaginal entrance is found closed. There may be a bulging of the hymen due to the pressure of menstrual blood behind it. If the atresia is situated high in the vagina, the vaginal entrance is found open, but after the examining finger has been introduced for a short distance it meets an obstruction, consisting of a wall of tissue blocking the vagina. If there is a collection of menstrual blood behind the obstruction, fluctuation may be obtained. Digital examination by the rectum will give additional information as to the location and length of the vaginal atresia and as to the amount of menstrual fluid collected behind it. In long-standing cases the vagina and uterus and even the fallopian tubes may be distended with blood.

In cases of atresia of the vagina there are likely to be other malformations higher, and sometimes the uterus is entirely absent. If the patient is past the age of puberty and no collection of blood is found above the vaginal atresia, the strong probability is that the uterus and appendages are either absent or so poorly developed that menstruation would be impossible even though the vaginal obstruction were removed. Careful examination should be made to determine certainly whether or not the uterus is present.

In opening into the blood collection in a case of imperforate hymen, careful asepsis must be maintained, for the old blood is a culture medium for the rapid growth of any bacteria introduced, and if the collection extends to the uterus and tubes serious sepsis may result. The remedying of any defect greater than imperforate hymen requires special surgical work, the details of which are given in the authors' *Operative Gynecology.*

2. General Diseases

General diseases may cause amenorrhea by depressing the functional activity of the endocrine system or by affecting the general nutrition through vitamin deficiency or damage to the blood or organs, or by a combination of these effects. Chronic diseases, such as tuberculosis, malaria or syphilis, which

tend in one way or another to depress the vitality of the patient, may cause amenorrhea. Acute diseases, especially mumps, occasionally cause enough ovarian damage to produce amenorrhea.

The importance of nutrition in amenorrhea has long been recognized and all of our more recent knowledge on the relationship of vitamins to endocrine function has emphasized the need for a diet adequate in *vitamins, minerals* and *calories*. As mentioned in Chapter I, W. M. Allen demonstrated regressive changes in the pituitary and ovaries in undernourished animals fed on low calorie diets even though the vitamin contents of the diets were adequate. Clinically it is known that in the overweight patient endocrine function is sometimes restored to normal merely by bringing the weight down to normal by diet, this being especially true at puberty.

The same is true when undernourishment is corrected, and in patients who cannot be made to gain by diet alone *insulin* may be given before meals, as suggested by Thayer, to increase the appetite and aid in the absorption of the food given. Liegner, in two cases of long-standing amenorrhea in undernourished young women, initiated menstruation by insulin and high carbohydrate feedings plus intravenous glucose. Both cases had previously been given prolonged ovarian and pituitary therapy without success. At the start of the treatment he used twenty units of insulin three times a day and gave intravenous glucose every second day until the patients began to make consistent weight gains; then the therapy was continued with smaller doses of insulin and a high calorie diet until a normal weight was attained.

Simple anemia is frequently a factor in the causation of amenorrhea and, if present, should be corrected by *iron* administration, preferably a product containing ferrous sulphate, trace of copper, and vitamin B complex.

3. Endocrine Dysfunction

If the amenorrhea cannot be accounted for by any of the above conditions, an endocrine investigation is indicated.

The basal metabolism test is usually the first step in the investigation unless there are definite signs or symptoms pointing to one of the endocrine glands as the cause. A lowered thyroid function is a frequent cause of amenorrhea, especially in girls from sixteen to twenty years old.

The thyroid dosage should be about one grain of desiccated thyroid daily to every minus ten of the basal metabolism, but this dosage can be raised or lowered according to the response to treatment. Usually the thyroid must be taken through the menstrual life of the patient, though occasionally we find a case in which it can be discontinued after some months of treatment.

If there is no improvement in the amenorrhea after some months of treatment, it usually means that the seat of the trouble is elsewhere and further investigation is needed.

The following is the plan of investigation for a patient with amenorrhea of probable endocrine origin.

1. In the history and physical examination, note especially the points indicative of endocrine disturbances, such as hair and fat distribution and development of secondary sex characteristics. The pelvic examination should rule out a tumor which may require removal (such as arrhenoblastoma), congenital defects, etc. Signs suggestive of basophilic adenoma of the pituitary or of hyperplasia of the adrenal cortex should be noted.

2. The usual special examinations include basal metabolism rate, x-ray of the sella turcica, sugar tolerance test, visual fields, and blood examinations.

3. The next step is to determine whether the patient is ovulating and, if so, the time of ovulation. The technique of Rubenstein, using vaginal smears plus the daily rectal temperature, should help to determine the important point of the day of ovulation. If the approximate time of ovulation is indicated by this curve, an endometrial biopsy two weeks later will decide the point.

4. If ovulation does not occur, it may be due to inadequate pituitary stimulation or it may be due to the inability of the ovary to respond to normal pituitary stimulation. In order to decide this point, the following test, suggested by Hamblen, is used. A dose of pregnant mare's serum is administered, using anteron (200 U.) or gonadogen (20 to 40 U.). This is given intramuscularly, after previous allergic study to rule out serum sensitivity. The dose is repeated daily for three or four weeks, during which time careful clinical observations are made, including a bimanual examination twice a week to evaluate alterations in the genital tract. In the pelvic examinations, special attention should be directed to the ovaries, and if cystic change occurs a rest period is allowed. Measurement of the uterine canal with the occasional endometrial biopsy will give accurate information on uterine and endometrial growth. The daily dosage should not be continued longer than three or four weeks at a time, because of the possibility of the ovaries becoming refractory due to antihormones or to lowered receptivity.

The country physician faced with the problem of outlining endocrine therapy for a case of amenorrhea naturally feels a certain inadequacy because of his inability to obtain the various hormone tests required in certain cases. This, however, need not deter him in his efforts, for much can be done in many cases with the ordinary diagnostic and treatment procedures. The intelligent use of the means at hand will enable him to treat successfully the cases which can be thus handled, and to differentiate the more serious cases which require the extensive investigations and radical treatment measures available in the large medical centers.

Ovulating Patient.—When on endometrial biopsy it is found that there is a well-proliferated endometrium, indicating a full estrogenic response, a dose of 80 U. of gonadogen is given intravenously, and this is followed by daily doses of 500 to 2,000 U. of urinary gonadotropins daily for fourteen days. During this time the urinary sodium pregnanediol glycuronide is followed, and at the onset of any bleeding an endometrial biopsy is carried out to see if a progestational endometrium is present.

If secretory activity is present, it indicates that ovulation has occurred and that the ovary has passed through its biphasic cycle. When this result is obtained no further treatment is given for six weeks, but observations are continued. If spontaneous ovarian activity does not follow, the gonadotropic therapy should be repeated several times. If still there is no further menstruation, then replacement ovarian therapy is instituted.

Nonovulating Patient.—If no response is obtained by the above investigation plan, that means that the ovaries or the endometrium or both are seriously deficient in functional power. Such marked deficiency is due usually to defective development of the genital apparatus, either alone or as part of a general underdevelopment, and hence is found principally in the poorly developed girl in whom normal menstruation has never been established.

The treatment of such a condition presents a difficult problem, but for the hopeless outlook of former years we can now substitute a good chance of suc-

cessfully aiding development, thanks to the great increase in the knowledge of pelvic physiology and endocrinology due to the splendid work of investigators in these fields.

The many details in the treatment of such a condition, with the examination points and the adjustments and variations in time and dosage of medicines used, are best presented by following the actual treatment of such a patient step by step. The following typical case is instructively detailed by Hamblen in an article in *Endocrinology*.

G. R., a single colored girl, 17½ years of age, had not begun to menstruate and had shown signs of incomplete sexual maturation. On examination she presented a classical syndrome of juvenile hypoövarianism. Her span exceeded her height by 5 inches and her lower measurement exceeded the upper one by 6.5 inches. Hands and feet were large and slender with long tapering digits. Her weight was 105 lb. despite a height of 67.5 inches. Characteristic feminine padding was absent. There had been slight physiologic hyperplasia of the breasts. There was a slight growth of pubic hair. The external genitals were markedly hypoplastic. The vaginal cavity was approximately 1.5 inches in depth; the fornices were undeveloped; the walls were thin, smooth and relatively inelastic; vaginal discharge was scanty. The cervix was flush with the upper vaginal vault and, in its size and character, resembled an urethral meatus more than a cervix. A small, flat, triangular uterus without convexity of the fundal portion was identified. The entire uterus and cervix were estimated not to exceed 1.5 inches in greatest dimension. A sound could not be introduced because of the hypoplasia; therefore, no endometrial biopsy was possible. Ovaries could not be palpated, nor any adnexal structures identified.

The basal metabolic rate was –4 per cent. Roentgenologic studies showed the sella turcica to be normal, and studies of the ankle, knee, wrist and elbow showed ununited epiphyses. The osseous age was estimated to be approximately 15 years.

No treatment was given except that of injections of gonadotropes. The patient was given injections of 200 R.U. of a gonadotropic extract from the pituitary (gonadotropic factor) on Oct. 28 and 30 and on Nov. 2, 4, 6, 9, 13, and 16 the total dosage was 1,600 R.U.

Clinical observations, including bimanual pelvic examination and cytologic studies of the vaginal fluid, yielded no significant data, except that there was an increase in the leucocytes of the vaginal smears on Nov. 4 and 16.

At this point treatment with a serum gonadotrope was begun. Doses of 100 M.U. of this gonadotrope were given on Nov. 20, 23, 25, 27, and 30 and on Dec. 2, 4, 7, 11 and 14, making a total dosage of 1,000 M.U. Examination on Dec. 16 showed a definite increase in the size of the genitals and of the vagina. The cervix and uterus had increased sufficiently in size so that a regular uterine sound could be inserted. This procedure indicated a uterine depth of 2 inches. An endometrial biopsy was made and the tissue obtained showed upon microscopic examination a good estrogenic response. On bimanual pelvic examination, the left ovary was felt and judged to be somewhat cystic and about normal size.

Treatment was discontinued at this stage to avoid possibility of the development of a secondary refractivity to the therapeutic agent.

The patient reported back on Jan. 13 (after an interval of 4 weeks). There had been no menstruation. Slight regression of the effects of treatment had occurred. An additional series of treatments with antex was given as follows: doses of 200 M.U. were administered on Jan. 13, 15, 18, 20, 22, 25, 27, and 29 and Feb. 1, 3, 5, 8, 10, 12, 15, 17, and 22, the total dosage for the series being 3,400 M.U. On Feb. 3, both ovaries were felt on bimanual pelvic examination and they were estimated to be about one-half normal size. Studies of vaginal cytology showed nothing significant except a disappearance of leucocytes on Feb. 10 and 12. At the conclusion of the series of therapy on Feb. 24, sounding of the uterus showed it to be 2.5 inches in depth. An endometrial biopsy was made and examination of the tissue obtained showed a well-developed progestational endometrium. Bimanual examination indicated the left ovary to be about normal in size and to have a soft cystic feel. The

right ovary remained small. Treatment was discontinued at this point to await develop-
ments and to test the therapeutic value of the alterations produced.

On Feb. 26, the patient began her first menstrual period which continued until March
2, and which appeared normal in all respects. The patient returned for further observation
on March 24. She had had no therapy since Feb. 22. She had had no further menstrua-
tion. Genital structures had shown no regressions since last examined. The uterus meas-
ured 2.75 inches in depth. An endometrial biopsy was made; the tissue obtained showed a
normal estrogenic endometrium. No treatment was initiated; observations were continued.

On April 7, another biopsy of the endometrium was made. The endometrium at this
time showed a well-differentiated progestational response. On April 8, the patient's second
menstrual period began. It continued until April 11 and was normal in all respects. No
further treatments were advised. Her last visit was on Aug. 18 when she reported regular
menses each month since April. Her last period had begun Aug. 4 and had lasted six days.
A general survey showed the following evidences of sexual maturation: an increase of weight
to 115 lb. with fat localized in a typical feminine fashion; increased hypertrophy of
breasts; increase in pelvic and axillary crines; continued hyperplasia of the genital structures;
roentgenologic evidence that all epiphyses except those of the radius and ulna had closed;
and ovaries, uterus, cervix and vagina appeared normal in size and character.

Occasionally, some general or local disease will cause this serious func-
tional deficiency type of amenorrhea in an individual who has menstruated to
some extent. Vesell reported the cure of amenorrhea of ten years' standing in
a woman thirty-one years of age and married eleven years. The patient even-
tually became pregnant and was delivered of a normal child. Vesell used
cyclic therapy with the urinary gonadotropic hormones alone.

More recently a combination of the urinary gonadotropin and the pituitary
gonadotropin has been used in the treatment of amenorrhea by Mazer and
Ravetz.

In their preliminary report on the use of this combination, called synapoidin, they were
able to evoke one or more menstrual periods in 19 of 23 severely amenorrheic women, and in
two of these the menses continued without further treatment. They warn against uncon-
trolled use of this very potent combination and state that they saw evidence of overstimulation
of the ovaries in twenty of twenty-three patients who received small amounts pre-
operatively.

Though it is impossible to evaluate the results from the meager reports to date, this
treatment seems to offer hope of success in therapy with the gonadotropes.

In patients who do not respond to the gonadotropic therapy, cyclic treat-
ment with the sex sterols is indicated. Some idea of the dosage needed and the
best time for administration can be obtained by the use of vaginal smears as sug-
gested by Papanicolaou and Shorr. They classify the amenorrheas into three
groups by vaginal smears as follows:

1. That characterized by the constant presence of the atrophic smear, a type which
may be interpreted as indicative of virtual absence of ovarian activity. This group in-
cludes most ''primary'' and many ''secondary'' amenorrheas.

2. That showing smears which are from time to time quite constant for the individual
and indicate some degree of subnormal but uniform ovarian activity. This group in-
cludes most of the ''secondary'' amenorrheas.

3. That showing irregular cyclic smear changes imitating those seen during the
normal menstrual cycle but which are, however, insufficient to produce overt menstruation
although they reflect periodic ovarian activity. This is the smallest group and includes
some ''secondary'' amenorrheas and adolescents with delayed puberty.

The "atrophic" type of vaginal smear is illustrated under menopause disturbances in Chapter XVI, where is given also a comprehensive table describing the transitional forms, which indicate whether or not the patient is receiving effective treatment. Groups one and two seldom respond to gonadotropic therapy while the remaining group usually does respond.

Since detailed examinations for the hormones in the blood and urine are not generally available, a discussion of their use in directing treatment would be of little practical value and hence it is omitted. For articles dealing with this subject, see those by Frank, Goldberger, Salmon and Felshin on the causation and treatment of amenorrhea, by Tamis on the management of secondary amenorrhea of functional origin, and by Hamblen on the gynecic employment of equine gonadotropins.

Cyclic therapy with the sex sterols was suggested in the early days of endocrine therapy by Novak. It is of course a substitutional therapy, but in some cases, especially of the secondary type, the production of several artificial periods sometimes helps the patient to establish her own cyclic mechanism and carry on without further treatment.

The underlying principle in the treatment is an attempt to initiate the normal menstrual cycle by supplying the hormones concerned in their usual sequence.

Beginning with oral administration of theelin (0.24 mg.) or amniotin or emmenin, two or three times daily, and of the same preparation hypodermically, 10,000 U. dose daily, the treatment is continued for fourteen days. The hypodermics of the estrin are then discontinued, and the oral administration is continued. On the seventh day pelvic massage is started to aid ovulation. Cervical dilatation may help, but the definite danger of infection must be remembered and strict antiseptic precautions employed. Prephysin (100 U.) or gonadogen (40 U.) should be started on the fifth day and continued daily until the sixteenth day as an aid to ovulation.

After the fourteenth day, a good progestin preparation, such as proluton, should be given daily to help promote premenstrual changes in the endometrium. A urinary gonadotropin also may be given during this period. On the twenty-sixth day another dose of an estrin product is given, with the final dose of proluton, and all medication is stopped. The patient should show signs of menstruation in from two to four days. If no period occurs, it is probable that the treatment has not coincided with the optimum cycle of the hormones in the patient's blood.

Of course if we have no tests we do not know when the patient's blood contains the maximum amount of hormone and hence we cannot know just when to supplement with an additional amount of the proper hormones. Because of this unknown factor we must try different periods in the month, hoping that one of the series of treatments given will coincide with the optimum cycle of the patient. For this reason the next series of treatments should be started nine days after the last dose of medicine was given, so that this second series would be started five weeks after the first one. Each one is started nine days after the preceding one, and in this way there is a greater possibility of coinciding with the normal hormone cycle of the patient.

If the patient responds to this treatment, then an attempt is made to keep the periods coming until the patient is able to establish her own cycle. This is done by continuing the preparations given by mouth, using pranone, 5 to 10 mg. daily, for the corpus luteum product. The hypodermic medication should be used if needed to supplement the medicine given by mouth. Many patients will gradually improve, so that later the oral medication also may be discontinued. Thyroid, if needed, should always be given with the above outlined treatment.

Zondek, Rozin and Vesell reported causing bleeding in secondary amenorrhea by means of progesterone. They used 5 mg. daily for ten days, and bleeding occurred 60 to 72 hours after the last hormone injection. In primary amenorrhea, the endometrium was first primed with 20,000 I.B.U. of estradiol benzoate distributed over a four-day period, after which the ten-day course of progesterone was given. Several normal periods followed in some of the cases of amenorrhea, but there were no permanent results. In two of our cases we used progesterone with satisfactory temporary relief.

If the medication causes no flow or premonitory signs, then the question arises as to whether it is wise to continue treatments. It may be well to try another series in the spring and fall of the year, as an occasional patient is seen in whom the fundamental pulse of estrus resembles that seen in lower animals. We have had one patient who menstruated only twice a year—in the spring and in the fall.

If the endocrine make-up of the patient is entirely inadequate, it should be explained to her that the absence of menses has little deleterious effect on the general health. If the question of the possibility of pregnancy later arises, it can be stated that the condition does not entirely exclude the possibility of offspring, but that the chances for progeny are not good. A patient of ours became pregnant during a period of amenorrhea which lasted more than two years.

X-ray and radium are usually contraindicated in adolescent amenorrhea, because here we are dealing with immature ovaries which may be unduly sensitive to radiation. Mazer limits this type of treatment to patients aged seventeen or older.

An arrhenoblastoma of the ovary would be an indication for operative treatment as would hyperplasia of the adrenal cortex.

In a case of amenorrhea where the girl is engaged to be married, the question of the propriety of the marriage sometimes comes up, the parent or the patient desiring to know whether it would be right for her to marry when she has never menstruated. The answer is that the case should be thoroughly investigated according to the plan outlined, to determine whether or not there is any serious trouble that would interfere with childbearing (see page 809).

B. WHEN THE PATIENT HAS MENSTRUATED

When the patient has menstruated and later ceases, the amenorrhea may be due (1) to physiologic amenorrhea, (2) to some general condition, (3) to pelvic lesions or treatment, or (4) to endocrine dysfunction.

1. Physiologic Amenorrhea

Normal Pregnancy.—If the patient has previously been regular in menstruation, is in good health and has had an opportunity to become pregnant, the natural supposition is that she is pregnant, and until it is proved that she is not pregnant, nothing should be done that could in any way interfere with pregnancy.

The patient may assert positively that she is not pregnant, may even deny any possibility of pregnancy, but when after examination there is any suspicion in your mind, postpone all local treatment until after the next menstrual flow. If you doubt the patient's

honesty—that is, if you think she may return and tell you that she menstruated when in fact she did not—tell her that she must come during the flow, that you may determine the character of the flow. In this way you can establish certainly whether or not she really menstruates.

In this matter of the question of pregnancy it requires considerable judgment and tact, on the one hand, to detect the cases of pregnancy, and, on the other hand, to avoid wounding the feelings of innocent persons by ill-advised questions. Concerning the question of pregnancy, the cases may be divided into three classes. In the first class come the girls and unmarried women in whom, from the character of the trouble or from the known character of the patient and the examination findings, the possibility of pregnancy may be at once eliminated. These correspond very closely with the patients who have never menstruated and require the same treatment.

In the second class come the married women. If the diagnosis is still doubtful after examination, the patient is told that it is too early yet to be certain about it, and she is directed to come again after a month or six weeks. If the patient is anxious to know at once, an Aschheim-Zondek test may be made.

In the third class come the girls and unmarried women about whom you know but little—they may be all right or they may be all wrong; you simply do not know and hence must be cautious. In this class come also widows, divorced persons, women living apart from their husbands—all of whom, if pregnant, might wish to conceal the fact. Some of these patients are perfectly truthful with the physician, telling him their fears or leaving a clear opening for the asking of questions that would bring out the information. In other cases the patient gives the whole history of her case without any intimation of a misstep. Occasionally the patient tries deliberately to deceive the physician, hoping that in his examination or treatment something may be done that will bring about an abortion.

In such uncertain cases it is usually best for the physician to keep his thoughts to himself, and not to intimate any suspicion of pregnancy until some good evidence of it is found. Do not depend too much upon the history the patient gives. Just keep in mind that it may be all truth and it may be all falsehood. If after examination there is still doubt, an Aschheim-Zondek test will ordinarily be decisive in the matter. If this is negative, the prostigmine test should be tried. This consists in giving 1 c.c. of 1:4,000 prostigmine by hypodermic daily for three days. If the patient is not pregnant and has no marked endocrine disturbance, she will menstruate shortly after the last dose. To date this procedure has never been known to cause abortion.

In the exceptional cases where it is thought best not to suggest the possibility of pregnancy at the time of local examination, a specimen of urine may be requested on general principles, and the pregnancy test made. From three to four ounces of morning urine is satisfactory for the laboratory work. In this way the physician protects himself and at the same time gives the patient good treatment. If it turns out that no pregnancy is present, the patient need never know that pregnancy was suspected. On the other hand, if it turns out that pregnancy is present, nothing has been done that could possibly interfere with it.

Extrauterine Pregnancy.—The evidences of tubal pregnancy have already been given in Chapter XI. In the case of a doubtful pelvic mass the Aschheim-Zondek test may help in differentiation.

Lactation.—As a rule, a woman does not menstruate while nursing a baby. There are, however, many exceptions to this rule, especially after the first six months. Quite frequently a patient, while nursing her child, will begin to menstruate within five or six months after labor and occasionally within two or three months. This happens most frequently in those cases in which the mother has only enough milk to partly nourish the baby.

Beginning Menopause.—The age at which the menopause begins varies much in different persons. The average age is about forty-five, but it often begins somewhat earlier, in exceptional cases before forty. If the patient is past forty

and the menstrual flow has been getting gradually less for several months, the menopause is probably beginning. There are two separate phenomena that usually accompany the climacteric and that may aid in the diagnosis—the "hot flashes" with some irritability and other evidences of nervousness, and the tendency to increase in the subcutaneous fat deposit. Neither one of these is pathognomonic, but both of them occurring in a patient past forty, with menstruation gradually diminishing, make the diagnosis of the climacteric fairly certain.

2. General Conditions

Sudden mental shock will sometimes cause a very persistent amenorrhea in normally menstruating women. The mechanism of this is not understood but it may be due to an indirect adrenal effect on pelvic function. It is well known that psychoses usually upset menstrual function.

Acute and Chronic Diseases.—These have been discussed under primary amenorrhea.

Changes in Routine or in Climate.— A long journey (particularly on the ocean), change of residence from country to city or vice versa, extraordinary grief, joy, anxiety, or exciting work, study (as in preparing for examinations), taking up a new occupation, financial troubles, love affairs, and difficulties in home life. Any of these may cause an expected menstruation to be missed.

When the amenorrhea is apparently due to these causes, it is usually a sign of slight endocrine deficiency and as a rule is due to a mild hypothyroidism.

3. Pelvic Lesions or Treatment

The local diseases that may cause amenorrhea, independent of their general effect on the blood, are those diseases that affect the integrity of the endometrium (from which comes the menstrual blood) or that affect the integrity of the ovaries (from which comes the menstrual impulse).

Hyperinvolution of the Uterus.— The process of involution following pregnancy and labor may continue farther than normal, reducing the uterus below normal size and so modifying the endometrium as to interfere with menstruation. This is a rare condition, but must be kept in mind in considering a case of amenorrhea in a patient who has given birth to a child within a year or two.

In one of the authors' cases the patient was twenty-eight years of age. Three years before she had had a severe infection following the birth of her child, and there had been no menstruation since. Bimanual examination showed the uterus to be very small. On account of other trouble it was necessary to open the abdomen, and the opportunity of inspecting the internal genital organs was offered. Everything was atrophic—the uterus, ovaries, tubes, and round ligaments. The uterus was about half the normal size. Hyperinvolution may occur also following simple curettage for chronic endometritis, though that is even more rare.

The treatment in such a case is to try to restore the functioning power of the uterus by active endocrine treatment.

Chronic Metritis.—Long-continued inflammation of the uterine wall may so disturb the blood supply to the endometrium as to interfere with its functions. The treatment is to attempt restoration of function by endocrine medication,

unless the troublesome symptoms from the chronic metritis and associated adnexal inflammation are so marked as to call for hysterectomy.

Dilatation and curettage may act as nutritional stimulants to poorly functioning uterus or ovaries, and Anspach recommends them in selected cases of persistent amenorrhea. Transplantation of tissue (endometrial or ovarian) may be employed in exceptional cases.

Solomons grafted some endometrium and a portion of ovary, obtained from a patient being operated upon for myomas of the uterus, into a twenty-eight-year-old patient who had been amenorrheic for three years. The amenorrhea had followed a pelvic operation complicated by mumps during the convalescence. The transplantation operation was followed by the reappearance of the menses in two months and the periods had recurred regularly at the time of the report, which was six years after the operation. He mentions that there were some adhesions about the remaining ovary which were freed at the time of the second operation, so this might possibly be a factor in the cure.

Hysterectomy.—The removal of the uterus ordinarily means cessation of menstruation. In certain cases of supravaginal hysterectomy for fibroids, sufficient of the lower part of the corpus uteri may be preserved to continue menstruation. Of course, such an operation constitutes only a partial amputation of the corpus uteri. The removal of the cervix uteri alone has practically no effect on menstruation.

Ovarian Disease.—With most ovarian diseases extensive enough to cause amenorrhea, the ovarian disease overshadows the amenorrhea in importance. There is, however, one exception, namely, thickening of the capsule of the ovaries. This may be sufficient to prevent ovulation and menstruation without otherwise troubling the patient. Operation by stripping off portions of the thickened capsule of each ovary is sometimes necessary. It is employed of course only after less radical measures have been thoroughly tried.

Bailey reported such operation on the ovaries in seventeen cases of secondary amenorrhea that had had previous endocrine therapy without result, and thirteen of these cases showed a successful result with the establishment of regular periods following operation. While recognizing the inadvisability of subjecting young women to laparotomy, he feels that it is justified in the following types of cases: (1) When endocrine therapy fails to establish regular periods. (2) When multiple cystic changes in the ovaries can be detected and endocrine therapy does not correct the condition. (3) When time itself does not rectify menstrual function one should not wait until all hope of help has passed. (4) When the psychic need for menstruation is important.

In rare instances the grafting procedure used by Solomons, previously mentioned, may be indicated.

Double Oophorectomy.—The complete removal of both ovaries (removal of all ovarian tissue in the pelvis) causes menstruation to cease, either at once or within a short time. In many cases, even with both ovaries badly damaged, enough ovarian tissue may be left to continue menstruation. In suitable cases this is the practice ordinarily followed. To secure the desired result, however, the ovarian tissue left must continue to functionate.

On the other hand, in exceptional cases, when both ovaries have supposedly been completely removed, the patient has continued to menstruate and has even become pregnant. That means, of course, that some ovarian tissue was left.

Some part of the normal-shaped ovaries may have been unwittingly left or there may have been lobulation of one ovary. Islands of ovarian tissue, from malformation of ovary, are occasionally found in the pelvis, either close to the normal site of the ovary or at some distant part of the broad ligament.

The removal of one ovary has little or no effect on menstruation, provided the other continues to functionate. The removal of one or both fallopian tubes has no effect on menstruation.

Radiation.—X-ray treatment or radium treatment may stop menstruation temporarily or permanently.

4. Endocrine Dysfunction

Endocrine disturbance is an important cause of amenorrhea in patients who have menstruated as well as in those who have not. Imperfect functioning of the ovary or other endocrine gland is partly responsible for amenorrhea and scanty menstruation ordinarily attributed to poor general health, to acute general or local diseases, to obesity and to nervous impressions. It is wholly responsible in still other cases, and in these the endocrine treatment outlined under Primary Amenorrhea should be followed through to restoration of function.

In these mature patients low-dosage x-ray therapy has proved remarkably successful in overcoming persistent amenorrhea and accompanying sterility. It must, of course, be administered by a skilled radiologist in conjunction with examination and advice of a gynecologist, for radiation is double-edged and can harm as well as benefit.

Several techniques are used and for details the reader is referred to the articles by Kaplan and by Mazer and Goldstein.

In 1943 Mazer and Greenberg gave the results of a long-time follow-up of their patients so treated. Reidenberg had reported on 136 of them treated between 1927 and 1937. Of the amenorrheal 71 per cent and of the oligomenorrheal 78 per cent were still menstruating at normal intervals. Eighty children were born to these women and no deleterious effects were observed in the children, some of whom are now of high-school age. In ninety later cases with a follow-up of nearly three years, sixty-five of the patients have continued to menstruate normally. Fifty-four were sterility cases in which the sterility had persisted in spite of organotherapy and other measures. Thirty of these conceived and twenty-eight carried to term, with healthy children, and the other two aborted early.

SCANTY MENSTRUATION–

A diminution in the menstrual flow, or a too slight flow from the beginning of menstruation, is caused by the same condition that leads to absence of the menses (with the exception of those obstructive lesions that prevent the escape of any blood), and the treatment also is practically the same.

PAINFUL MENSTRUATION (DYSMENORRHEA)

Dysmenorrhea is one of the most frequent symptoms met with in gynecology and, in some cases, it is one of the most difficult to treat. Stone estimates that 35 per cent of all women complain of some pain with menses.

Among 1,400 women students at the University of California, Cunningham found that 50 per cent complained of *some* pain and 35 per cent complained of *severe* pain. The question of the degree of pain a patient has depends, of course, entirely upon her interpretation of a subjective symptom, and this fact makes the investigation and evaluation of treatment very difficult.

The subject can best be covered by discussing therapy, and referring under each kind of treatment to the theories or facts upon which the therapy is based.

The term dysmenorrhea includes all degrees of pain, from that causing slight inconvenience to severe pain confining the patient to bed and in some cases requiring the use of opiates. Wide variation in the individual threshold for pain determines to some extent the disability and, of course, this must be considered in planning treatment.

Since there is no single cause for dysmenorrhea, classification for treatment is difficult, for, though certain types can be classified on an etiologic basis, it is impossible, as will be explained later, to classify endocrine therapy on the basis of etiology. For convenience the following outline is used in the discussion of therapy.

1. Mental and physical hygiene.
2. Pelvic and extrapelvic lesions.
3. Allergic causes.
4. Neurogenic causes.
5. Mechanical causes.
6. Endocrine causes and therapy.
7. Premenstrual tension.

1. The importance of **mental** and **physical hygiene** has long been recognized. We all know of instances where dysmenorrhea has been consciously or subconsciously used as a shield to avoid an unpleasant situation. Many girls have been brought up to believe that one is supposed to be ill at the menstrual time. The very words used to describe the event, such as "unwell" and "sick time," certainly help to foster this false idea. An illustration of what can be done by hygienic instruction is shown in an article by Clow. She was able to reduce the incidence of dysmenorrhea in an English girls' school 70 per cent by having the girls take warm showers and moderate exercise during their periods, laxatives and diet as needed, and by explaining to them that menstruation is a normal function. For hypnosis, see Kroger and Freed (1943).

Faulty posture is considered an important cause of dysmenorrhea by Adams and he reported that he was able to relieve a number of cases by postural correction. In contradistinction to this, Miller, in observations on 302 college women over a four-year period concluded that posture is not a factor in dysmenorrhea.

2. The **pelvic lesions** most frequently causing dysmenorrhea are endometriosis and adenomyosis, ovarian cysts, pelvic inflammatory disease, and occasionally uterine displacements.

With endometriosis, the ectopic bits of endometrial tissue menstruate with each period, forming hematomas filled with the typical chocolate-colored material. Since there is no avenue of escape for the menstrual discharge, these

isolated glands become markedly distended with each period and the distention causes pain. The pain in this condition usually is most marked just before and during the period.

Payne in a series of 307 cases of endometriosis found that he was able to determine the onset of the pain in relation to the period in 92 patients. He gives the following table:

Premenstrual	18 per cent	
Pre- and intramenstrual	25 per cent	93 per cent
Intramenstrual	50 per cent	
Intra- and postmenstrual	4+ per cent	
Postmenstrual	1+ per cent	
Intermenstrual	1- per cent	

The pain is described as "boring or grinding" in character. In adenomyosis of the uterine wall the pain is usually most severe in the latter part of the period and for a day or so after the period.

In an attempt to determine the importance of the uterine position as a cause of dysmenorrhea Bell and Parsons made a study of the women students at the University of Michigan.

Of the 840 women students 12 per cent complained of severe dysmenorrhea. Of the 12 per cent the uterus was retrodisplaced in 43 per cent, it was acutely anteflexed in 9 per cent, while in the remaining 48 per cent the uterus was in normal position. Twelve of the dysmenorrheic women required opiates for relief at the menstrual time, and, in these the uterus was retroflexed in seven, acutely anteflexed in one, and in normal position in the remaining four.

A trial of pessary treatment is helpful in determining whether in a given case the retrodisplacement is the factor causing the pain. If a pessary cannot be fitted, the knee-chest posture will relieve some cases.

Extra-pelvic lesions in which dysmenorrhea is occasionally a symptom are ureteral strictures and a chronic appendiceal irritation in a low-seated appendix. Hunner of Baltimore was the first to call our attention to ureteral strictures as a frequently overlooked cause of dysmenorrhea.

In 1928 one of us (R. J. C.) spent a day with Hunner going over the histories and x-rays of cases of this type. After seeing numerous cases in which the patient had had one or two operations for relief of the dysmenorrhea without result, and then to see these cases relieved after ureteral dilatation, was thoroughly convincing that this condition must be kept in mind in searching for a cause for pain in the obscure cases. In 1939 Sears reported 14 cases in which dilatation of the ureteral stricture cured the dysmenorrhea. Most of these patients had had operations either for chronic appendicitis or salpingitis.

In cases in which severe nausea and vomiting are associated with the dysmenorrhea a low-seated appendix which hangs down in the pelvis should be ruled out. We recall two such cases in particular in which simple removal of the appendix gave the patients complete relief. In one of these the appendix was so firmly attached to the ovary that a small wedge of ovarian tissue had to be taken in order to remove the appendix. Previous dilatation had not helped in this case.

3. The importance of **allergy** was first mentioned by Duke in his monograph on asthma and allergy. The first extensive series of cases, however, was reported by D. R. Smith.

He found that the three symptoms complained of most frequently were dysmenorrhea, mucous vaginal discharge, and irregular menses. The foods most frequently giving positive reactions were: wheat, eggs, milk, chocolate, fish, beef, pork, nuts, beans, peppers, cabbage, and cauliflower. The treatment consists of elimination diets and in cases where definite allergy was present, the results were strikingly good. The allergic factor was proved in some cases by a return of the pain after discontinuing the diet. The importance of keeping the allergic factor in mind in searching for a cause of dysmenorrhea in a given case is emphasized in a later article by D. R. Smith and Otto Schwarz. In the 26 cases reported by them 5 had had abdominal operations and 3 had had, in addition, dilatations without relief. The sensitivity of uterine muscle to the allergens has been known for years and the most satisfactory tissue for testing the relative potency of the various allergens is the uterine muscle of a guinea pig.

4. The **neurogenic factors** causing dysmenorrhea have been investigated by Kieffer. He found that stimulation of the internal os caused uterine contractions, cervical spasm, and pain. From his study he concluded that the cervix was a sphincter with its tone governed by a reflex arc through the lumbar cord and the cervical ganglia of Frankenhauser. Kieffer feels that the spasmodic pain experienced in cases of dysmenorrhea may be due to an abnormal state of the cervical ganglia. This theory has received support from the practical work of Blos and also of Kennedy.

The former cured 90 per cent of his dysmenorrheic patients by injecting the cervical ganglia with 70 per cent alcohol. The technique of this injection method is given by Davis who reports permanent results in six cases. She injects 1 c.c. of 85 per cent alcohol into the Frankenhauser ganglion under evipal anesthesia. She emphasizes that the procedure is not free from danger. Certain drugs are said to secure their results through their action on the nervous mechanism. Hundley, using benzedrine sulphate, reported complete relief in 61 per cent of 186 attacks, using one or two 10 mg. doses. Atropine, syntropin, mecholyl, and adrenalin have all been used with relief in some cases. Ainley obtained good results using a capsule containing aspirin 5 gr., phenacetine 3 gr., and propadrine hydrochloride ¾ gr. The use of calcium gluconate 60 gr. daily for two weeks before the period gave relief in 70 per cent of 49 cases in one series. The calcium lessens the irritability of the muscles and nerves.

In severe cases of dysmenorrhea of any type where all conservative measures have failed, relief can usually be obtained by resection of the presacral nerve as recommended by Cotte, Leriche, Wetherell, Behney, and others.

5. **Mechanical obstruction,** because of a pin-point opening, stricture, tight internal os, acute anteflexion, polyp or fibroid, is the cause of pain in some cases. The exact mechanism of the relief secured by dilatation is not known but two theories are advanced:

a. Relief of tension in the uterine cavity. It seems reasonable to assume that the increased tension from stenosis would tend to make the uterine contractions painful, as it does in the intestine and other hollow organs.

b. By the mechanical dilatation stimulating ovulation, as does an electric current in the canal. This seems opposed to the general assumption that non-ovulatory menstruation is painless.

The diagnosis of the obstructive factor in the complex symptomatology is made from the abrupt onset of severe cramping pains just preceding the flow and their relief when the flow is well established, along with the usually associated small cervix and small cervical opening.

The technique of office dilatation consists in gently introducing graduated dilators past the internal os under antiseptic precautions, starting with a small size and advancing to the largest that can be easily introduced. The dilators are shown in Fig. 279. It is well to leave the last one in the dilated cervix for several minutes. In married women, the dilatation is carried out in the pre-ovulatory interval. E. L. Stone, in reviewing the various treatments for primary dysmenorrhea, concluded that his best results were obtained by dilatation.

If a patient obtains temporary relief by office dilatation, then it is probable that a more lasting result will be secured by thorough dilatation under anesthesia followed by the insertion of a hard rubber stem (Fig. 1071) or the soft thick-walled rubber-tube stem (Fig. 1072).
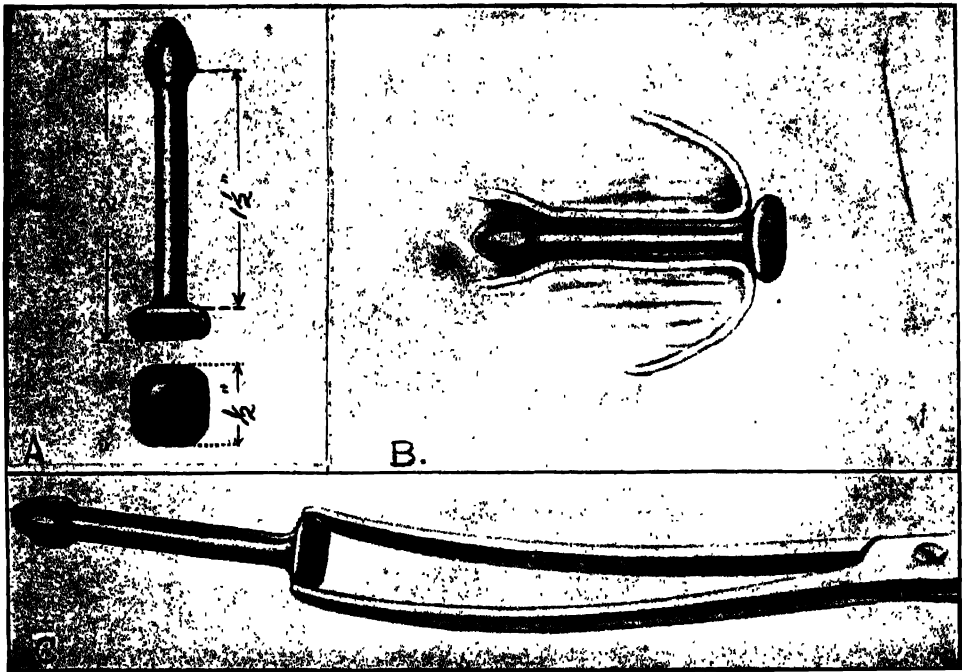
Fig. 1071.—Improved stem of hard rubber, for use in the cervix to maintain a good-sized canal after dilatation for stenosis. *A,* Dimensions of stem. *B,* Stem in place in dilated cervical canal. *C,* Showing the use of the flattened areas on the base, by which the stem may be grasped with a forceps for introduction or for removal. (Crossen and Crossen—*Operative Gynecology.*)

Various forms of metal, glass, and hard rubber stems have been employed for this purpose. The stem shown in Fig. 1071 is the most satisfactory of this type. The marked shoulder at the inner end usually keeps its place above the internal os, and the flattened areas at the outer end facilitate handling with forceps. However, the shaft of the hard-rubber stems, being only ¼ inch in diameter, does not maintain the wide dilation desired, and in many cases there is more or less recurrence of the stenosis. Consequently, in the severe cases with a very resistant internal os which contracts back to small as soon as the dilator is removed, we try to hold the wide opening gained by dilatation by using the larger rubber-tube stem.

Rubber-Tubing Stems.—In an endeavor to maintain the secured dilatation practically to the full extent for the first week or two, we employ thick-walled rubber tubing which fits the secured dilatation, instead of the regular hard rubber stem. Three sizes of pure gum rubber tubing are on hand for this purpose (Fig. 1072, *A*), the largest being ½ inch in diameter (outside measurement) about ⅛ inch wall thickness and 5⁄16 inch hole, and

the other two $\frac{7}{16}$ inch and $\frac{5}{8}$ inch outside measurement, respectively. Pieces an inch and a half long are cut, and one end rounded to facilitate introduction. These are sterilized and kept ready for use in cases of dilatation for obstructive symptoms.

This rubber tubing with thick walls as specified has the advantages that (a) it is stiff enough to maintain practically the full dilatation secured, (b) the central opening allows escape of fluid and prevents back pressure during uterine contraction, which is a necessary provision when trying to maintain such wide dilatation, (c) the size may be selected to fit the extent of dilatation secured, and (d) rubber tubing is always at hand, as it may be easily secured in required sizes at small expense.

After securing the full dilatation which is safe in that case, the size of rubber-tubing stem is selected to fit that dilatation. To facilitate removal it is well to pass a piece of strong braided silk through the wall of the tube well up from the end. A large Mayo needle threaded with the silk is passed inside the tube (Fig. 1072, B) and out through the wall. The two ends are then tied together to form a strong loop, as in Fig. 1072, C, which may be grasped for removing the tube. The tube is then dipped in A-G solution (1 per cent solution of neutral acriflavine in glycerin) for lubricating and antiseptic effect. After introduction well past the internal os, the tube is fastened in place by a suture through it and including the cervical wall (Fig. 1072, D). The large soft rubber stem should be left in place for a week. In a severe case, it is well to leave the stem in place in the uterus until after the next menstruation, if the patient can be kept under observation so that the stem may be removed should any symptoms of irritation develop.
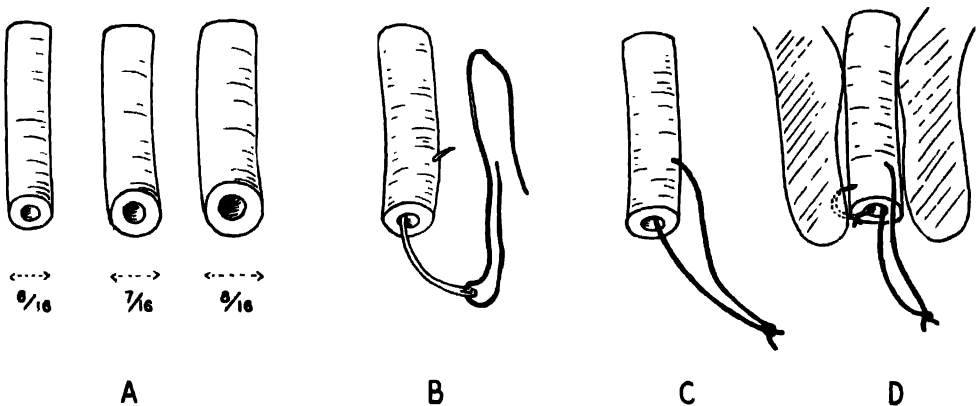
Fig. 1072.—Rubber-tubing stems. A piece of thick-walled rubber tubing is used, instead of the usual hard-rubber stem, to maintain better widening of the internal os after dilatation for the obstructive factor in dysmenorrhea. A, Three sizes of rubber-tubing stems. They are 1½ inches long, with one end rounded to aid introduction. They are cut from three sizes of rubber tubing, the wall of each being about ⅛ inch thick and the width (outside measurement) being ⅝ inch, $\frac{7}{16}$ inch, and ½ inch respectively. The size is selected to fit the dilatation secured, so as to maintain that dilatation to the full extent as far as practicable.

When in place, the upper end of the stem should be well up past the internal os, and the lower end should be slightly *inside* the cervix, so as to avoid irritation of the vaginal wall. (Crossen and Crossen—*Operative Gynecology*.)

Thorough dilatation and curettage and stem give marked relief in most cases. It should be followed, of course, by treatment to overcome the other features in the case, namely, the endocrine disorder and the hypersensitive and hypercontractile uterine muscle. The duration of satisfactory widening of the canal is variable, usually continuing at least several months and sometimes several years or indefinitely. Though there is a tendency to return gradually toward the former condition, the narrowing of the canal seldom becomes as troublesome as before the dilatation.

In the exceptional cases in which the obstructive feature again becomes severe, relief from obstruction may be given by a special plastic operation on the cervix. This consists of splitting the cervix posteriorly and then sewing it in such a way as to maintain widening of the canal at the internal os. This operation, devised many years ago by Dudley, has proved effective in most of these exceptionally troublesome cases. The operation, how-

ever, must be carried out accurately, keeping in mind that the essential point is permanent enlargement of the internal os. The technical details of the operation are shown in Figs. 1073 to 1079. The steps of the operation are as follows:

a. The cervix is dilated thoroughly and the uterus curetted in the usual way.

b. The posterior lip of the cervix is then split longitudinally up to the vaginal vault, the incision being carefully continued internally up to and past the internal os. The constricting ring about the internal os should be divided sufficiently to admit a finger readily.
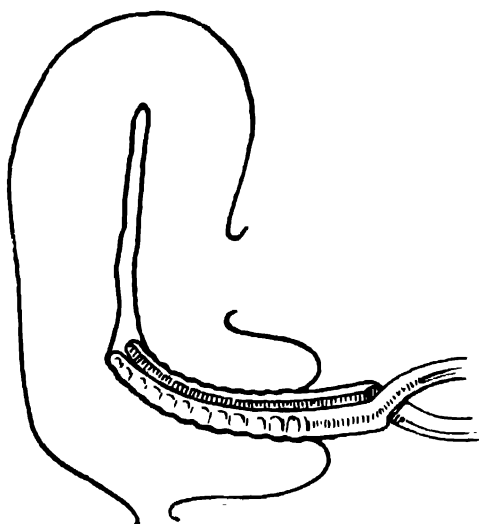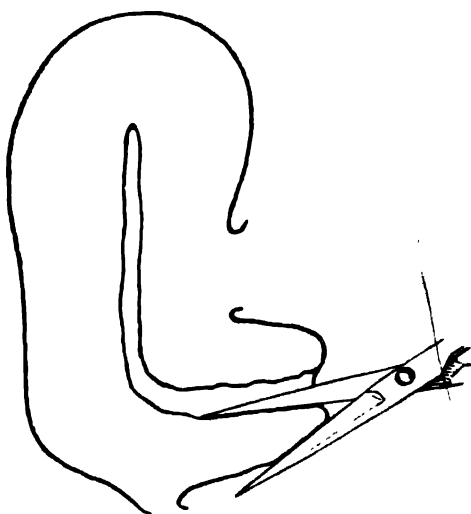
Fig. 1073.   Fig. 1074.

Fig. 1073.—Dilating the cervix, which is the first step in the operation of posterior division of the cervix.

Fig. 1074.—The scissors in place for division of the posterior wall of the cervix. A strong pair of sharp scissors is most convenient for this division, though a knife may be used if preferred. The higher division is preferably made with a knife, as shown in the next illustration
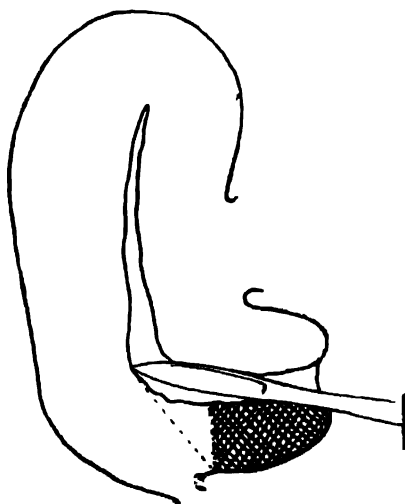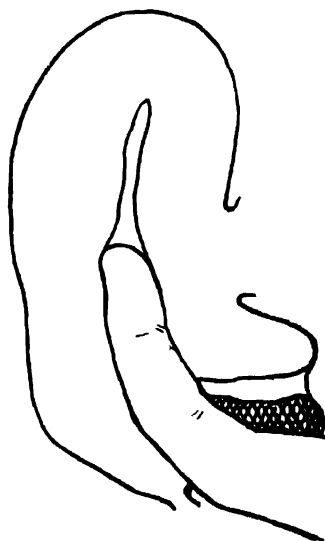
Fig. 1075.   Fig. 1076.

Fig. 1075.—Completing the division of the posterior wall up past the internal os. The dotted line indicates the limit of the necessary division. This division of tissue by the knife is made a little at a time under the guidance of the finger.

Fig. 1076.—The necessary division of tissue completed, permitting the finger to be passed up through the internal os. (Crossen and Crossen—*Operative Gynecology*.)

Care is necessary to avoid cutting too deeply into the uterine wall at this point, for, if the wall is cut through and the peritoneal cavity opened, there is danger of peritonitis. Ordinarily, there is no necessity for opening the peritoneal cavity. In some cases, however, the posterior peritoneal pouch comes very low or the internal os is situated unusually high. In either case, it may be advisable deliberately to open the peritoneal cul-de-sac in order to complete the operation properly. The division of the intravaginal portion of the cervix may be most conveniently made with long scissors (Fig. 1074). The careful division of the ring about the internal os is made with a bistoury under the guidance of the finger (Figs. 1075 and 1076).

c. A wedge of tissue is then cut out of each lip, as indicated by the dotted lines in Fig. 1077, so that each of the two cut edges will fold well on itself when the principal suture is tied.

d. A strong suture of chromic catgut or nonabsorbable material is then passed as shown by the main suture in Fig. 1078. This, when tied, folds the cut surface of each lip upon itself in such a way that the ends are brought into the angle of the wound (Fig. 1079), and this tends to hold apart permanently the divided tissues about the internal os. Before this main suture is tied, however, secondary sutures of catgut should be passed, as in Fig. 1078 at left, in sufficient numbers to close the lateral portions of the wound and prevent any hemorrhage. The main suture is then tied, and finally the secondary sutures.
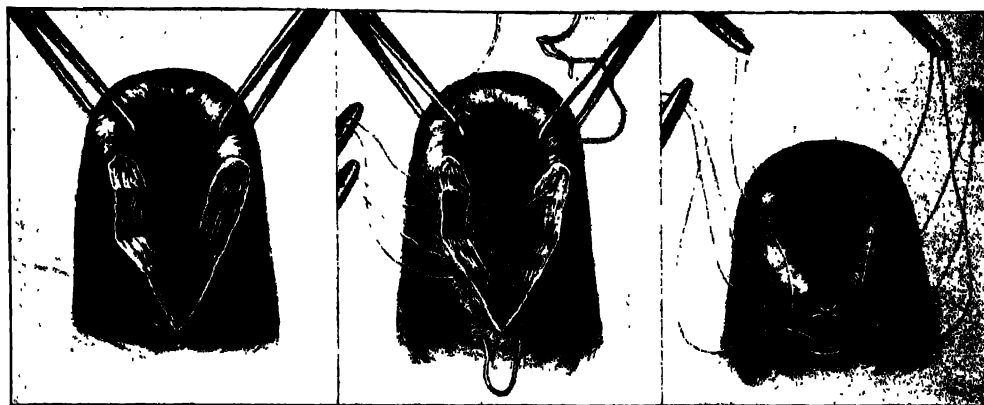
Fig. 1077.   Fig. 1078.   Fig. 1079.

Fig. 1077.—The posterior wall of the cervix divided. The wedge of tissue has been removed from one lip and the wedge to be removed from the other lip is shown in dotted outline.

Fig. 1078.—The sutures for closing the wound. The central approximation suture is in place, and also the lateral hemostatic sutures on one side.

Fig. 1079.—The central approximation suture tied, bringing tissue into the angle of the incision to keep the internal os open. (Crossen and Crossen—*Operative Gynecology*.)

It is important to pass the sutures deeply enough to catch the bulk of the divided tissue to prevent subsequent oozing. In one of our cases persistent oozing followed the operation and this increased after several hours to a flow of blood, which firm vaginal packing failed to stop and which affected the patient's pulse, and assumed serious proportions. The patient was placed in Sims' posture, all the packing removed, and two or three strong catgut sutures were placed deeply through the cervix in such a way as to constrict effectually all the tissue from which the bleeding might come. This was done without anesthesia and without disturbing the other sutures. It stopped the bleeding and the patient convalesced without further trouble.

e. In cases where the anterior lip of the cervix is very long it may be advisable to shorten it so as to allow the cervix better to assume its normal backward direction, instead of being again bent forward by pressure of the posterior vaginal wall. This is accomplished by excising the redundant portion of the anterior lip and closing the resulting raw surface by sutures passed transversely. This draws a good wedge of tissue into the angle between the cervix and corpus uteri and tends to push the cervix back toward its proper direction.

If the dysmenorrheic patient is engaged to be married soon, the examination under anesthesia with the dilatation and curettage should not ordinarily be carried out. Wait until several months after marriage before employing any local measures. In the meantime pregnancy may take place, and that will do more toward a permanent cure of the trouble than the most radical operative measure. The marked effect of pregnancy in these cases of dysmenorrhea is an additional indication that it is largely an endocrine and metabolic trouble. Pregnancy exercises a most profound influence upon the metabolism of the uterus and the ovaries. It has been argued that pregnancy and parturition produce the marked curative effect in these cases by overcoming the stenosis. Without doubt it does overcome the stenosis better than any other known measure, but, as has already been explained, the stenosis is only one feature of the trouble, and the removal of the stenosis alone does not always effect a cure.

We may confidently expect considerable relief from thorough dilatation and curettage in the great majority of the cases.

Wire stem pessaries, which are left in the canal for months, have been recommended. These may cause severe infection and abortion and for these reasons are considered too dangerous to use.

6. **Endocrine Causes** and **Therapy.**—Before discussing the hormones specifically concerned with pelvic physiology, it would be well to discuss two of the general metabolic hormones which have been found to relieve dysmenorrhea. These are thyroid and insulin.

Most of the *thyroid* cases with associated dysmenorrhea have a lowered metabolism and by administering thyroid alone, the pain frequently disappears. On the other hand, cases of interstitial thyrotoxicosis with an associated dysmenorrhea are occasionally cured when the thyrotoxicosis is treated and the overactive thyroid function corrected. Iodides and bromides are the drugs used, for example, potassium iodide 2 gr. and sodium bromide 12 gr. to the teaspoonful, and give a teaspoonful three times daily as needed.

It has long been known that there is a high incidence of dysmenorrhea among undernourished individuals. Quite by accident Altschul, while using *insulin* to treat a group of undernourished patients, found that the pain in dysmenorrheic patients was relieved. In order to determine whether the relief was due to the improvement of the malnutrition or to some unknown insulin effect he gave it to a series of normally nourished dysmenorrheic women and found that 10 of the 12 women treated were relieved.

Tedstrom and Wilson obtained relief of 80 per cent of dysmenorrhea patients by high carbohydrate feeding, suggesting that the underlying cause of the pain was hypoglycemia. Immediate relief occurred with intravenous glucose. They found that the same result was obtained in patients with normal blood sugar and hence concluded that the relief was due to the stimulating effect of the carbohydrate therapy on the pancreas causing it to secrete extra insulin.

Schrik obtained equally excellent results using 5 units of insulin before lunch daily, starting three to five days before the onset of the period and continuing through the period. The permanency of the relief had not been determined but some of the cases had had no pain for months after discontinuing the insulin.

In regard to **specific hormones,** as previously mentioned, treatments using the ovarian, testicular hormones, and the chorionic gonadotropins are based on

confusing, and in some cases diametrically opposed, *etiologic* bases. Hence it is best merely to outline some of the investigation in the physiology of the uterine muscle and then discuss therapy from an empiric standpoint.

The similarity of dysmenorrheic pains to labor pains or to those caused by a foreign body in the uterus led to the supposition that pain of functional dysmenorrhea was due to uterine contractions. Studies in normal uterine physiology by Reynolds, Novak, Wilson, Kurzrok, and others have shown that the contractions of the uterine muscle reach their maximum amplitude at the period time. They gradually diminish in amplitude in the postmenstrual period, reaching the minimum amplitude at the time of ovulation. In castrated animals uterine contractions disappear, but if the castrate is given estrogenic substances strong contractions occur. If, then, this is followed by progestin the contractions are markedly diminished. The same is true with the chorionic gonadotropins, due to the fact that in animals this hormone caused ovulation and hence corpus luteum formation and progesterone secretion.

Just as we all began to feel that at last the mysterious cause of endocrine dysmenorrhea had been settled, a contradicting article appeared last summer. Wilson and Kurzrok, using the intrauterine balloon method of testing dysmenorrheic women, found that there was no difference in the amplitude of uterine contractions in the normal and the dysmenorrheic women. This method, of course, is open to the criticism that any foreign body in the uterus will cause exaggerated contractions. They felt, however, that this factor could be ruled out as they waited to take their readings until the immediate stimulation caused by introduction of the balloon had worn off. These workers feel that functional dysmenorrhea must be regarded as a disorder in which the normal uterine contractions during the phase of maximum amplitude reach consciousness, and that the exact explanation for the reduction of the pain threshold is as yet unknown.

Another approach to the problem has been made by Phelps. He injected mature castrated does, having estrin-stimulated contractions, with the urine of normal, laboring and dysmenorrheic patients and recorded uterine contractions by the balloon method. He found that variations in contractions with urine of normal or parturient women were quite different from those caused by the urine of dysmenorrheic women, not only during the period but also between periods. He concluded that there was a marked imbalance in secretion of substances affecting uterine motility in dysmenorrheic patients.

In regard to blood levels, most workers find a high level in the majority of dysmenorrheic patients. Kotz and Parker, testing daily estrogen content in the blood and urine of 15 such patients, concluded that a high level of estrogenic substances is present in a majority of the cases of functional dysmenorrhea. The fact that the urine level is also high indicates to them that the high blood level is not due to faulty elimination of the estrogens by the kidney.

In regard to progesterone investigation, little has been done. Hamblen reported one case in which the urinary excretion of pregnanediol glucuronide was increased and the patient was relieved by estrogenic therapy. Cannon in a critical analysis of ''Modern Theories of Dysmenorrhea'' feels that membranous dysmenorrhea is due to ''overactivity of the corpus luteum, probably secondary to overactivity of the luteinizing hormone of the pituitary.'' On the other hand, in a series of endometrial biopsies done in dysmenorrheic patients, 64 per cent showed evidence of deficient corpus luteum activity. So the etiology remains uncertain.

Therapy will be discussed from an empiric standpoint. The interesting fact is that all of the treatments outlined give good results, which again warns that we must not forget the psychic factor.

Estrogenic Therapy.—The beneficial results obtained by estrogenic therapy have been explained in various ways.

Some think that the improved nutrition of the uterus is of importance, others that the pain is relieved because of the nutritive effect of the estrogens on the ganglia of Frankenhauser. Sturges and Albright feel that prevention of ovulation, indirectly by the

estrogenic inhibition of the pituitary, is the essential factor in the relief of the dysmenorrhea. They relieved 25 cases of severe dysmenorrhea by estrogenic therapy and in each case they showed that ovulation had been prevented. The physicians who believe in this method of treatment now go so far as to claim that, if a patient had dysmenorrhea, it is proof that she is ovulating normally.

Stilbestrol is being tried in this condition with some success, but since its toxicity is still an unknown factor it should be used with caution.

Technique for estrogen.—10,000 I.U. of estradiol is given intramuscularly every three days for six doses. The first injection must be given on or before the sixth day of the cycle to make this therapy effective. This treatment is repeated over a period of a year. The permanency of the result is still unproved.

Corpus Luteum.—The corpus luteum hormone has been used on the theory that since it diminishes the amplitude of the uterine contractions it should allay the pain.

Novak and Reynolds, and Campbell and Hisaw have reported success with this hormone, and the latter recommend 5 mg. of progestin daily for five days prior to the menses. They state that the results lasted several months.

Novak originally recommended pregnancy urine on the theory that it caused ovulation in the human, which idea has since been disproved. The effect which is occasionally obtained with pregnancy urine is probably due to a direct action on the uterine muscle. In an article last year Novak advised giving 200-500 U. daily for a week before the period.

Testosterone.—In the past year there have been several articles in the national journals on the treatment of dysmenorrhea with testosterone. The rationale of its use is based upon the fact that it has a dual action, one resembling the estrogenic effect and inhibiting ovulation, and the other, resembling a progesterone effect and reducing the amplitude of the uterine contractions.

If the testosterone is to be used subcutaneously 5 to 10 mg. are given on the fifth and eighth days prior to the period; if used percutaneously a preparation of 2 Gm. in sesame oil is massaged into the skin under each arm each night for ten days before the period. Abarbanel obtained excellent results with testosterone and had no trouble with masculinization effects. Patients of the masculine type should not receive the testosterone, as it has in some cases caused hair growth on the face, deepening of the voice, and other undesirable masculinization effects.

7. **Premenstrual Tension.**—Much has recently been written about premenstrual tension. The symptoms included under this term vary from headache, nausea, bloating, emotional disturbances with irritability and depression, to occasionally definite edema of various parts of the body. The cause of this distress is thought to be an excess of estrogen or a diminished amount of progestin. Recently Greenhill and Freed have advanced the idea that premenstrual distress is the result of tissue edema caused by a retention of the sodium ion in various body tissues, under the influence of an increased level of sex steroids in the blood.

It is well known that estrogens, androgens and some of the sex steroids can cause retention of the sodium ion which in turn causes an increase in the extracellular fluid resulting in microscopic or gross edema, depending upon the amount of fluid retained. The

symptoms under this theory result from edema: the headache from edema of the brain, the nausea and bloating from edema of the gut, and other symptoms from other organs involved.

The therapy used in selected cases, some of which had gross edema with the periods, was uniformly successful. The patients were told to refrain from adding table salt to their food for two weeks prior to the menstrual period and to take ammonium chloride, 10 gr., three times a day. The salt-free diet cuts down the intake of the sodium ion and the ammonium ion of the ammonium chloride is changed to urea, resulting in an increase of the chloride ion which in turn unites with the sodium in the extracellular fluid, increasing the excretion of sodium chloride. Water is lost from the extracellular spaces with the excretion of the sodium ion.

MENSTRUAL HEADACHE

In a patient inclined to headache, the menstrual period is the favorite time for the most troublesome manifestation, as it is for many other disturbances of the nervous system. There is not space for a general differentiation of the various types of headache which may occur at the menstrual time. The disturbed salt balance has been mentioned, and it is advisable to call attention to another troublesome type, which has recently been elucidated with considerable relief to the patients so afflicted. This type is characterized by exostoses on the inner table of the skull in the frontal region (Fig. 310) with resulting pressure on the "silent area" of the brain.

This condition is of interest to gynecologists in that it is the cause of one of the severe types of menstrual headache (often with visual disturbances) and not infrequently there are other menstrual disturbances, such as excessive flow or amenorrhea. Another point of interest is that the pelvic and other symptoms closely resemble those ordinarily associated with certain cases of pituitary dysfunction, and this diagnosis is very likely to be made and the exostosis overlooked.

The details of this condition were worked out by Dr. Sherwood Moore, professor of Radiology, Washington University School of Medicine. He investigated very extensively these inner-table exostoses, the resulting clinical symptoms, and associated bodily changes, and has called attention to their importance in an article (see Reference List).

The symptoms listed by Moore as characteristic of this condition are: 1. Headaches, often disabling. Cranial tenderness with sometimes a feeling of pressure. 2. The obesity may be extreme and is of the rhizomelic type. 3. Visual disturbances of various types. 4. Easy fatigue and muscular weakness. 5. The breasts are usually larger and more pendulous than they are in women who do not have hyperostosis of the skull. 6. Hair growth on the chin is common. 7. Mental dullness, dizziness, depression, and poor memory. 8. Epileptiform-like seizures. 9. Cranial nerve disturbances. 10. Regional sensory and motor disturbances, tingling, numbness, transitory hemiplegias and hemiparesis.

One of the clinical features of diagnostic importance is the fat distribution just to the middle of the upper arm and to the middle of the thigh. This is shown in Fig. 311, which is a photographic study from Dr. Moore's collection. The sella turcica was normal.

We have had several patients with this disorder. Dr. Carr, of the Department of Neurology, has obtained complete recession of troublesome symptoms in some of them on a diet high in gelatin.

W. M. Hull found that in some allergic patients with severe menstrual headache the sella turcica was of the closed type, which would cause troublesome pressure from any swelling of the pituitary which might take place at that time. He advised estrogenic therapy preceding the period.

INTERMENSTRUAL PAIN AND SPOTTING

The interesting subject of pain occurring at a certain time every month in the intermenstrual period has received considerable attention from investigators, and the conclusion has been reached that it is not an indication of any particular lesion.

Malcolm Storer, who reported 20 cases of his own and 25 additional cases collected from literature, found that in 10 of the cases there was a marked increase in the leucorrhea at that time, indicating congestion of the uterus. There may be a slight bloody flow at this time. In the 45 cases reported by Storer the pain appeared with regularity in all cases, practically every month unless pregnancy was present. In 22 cases it appeared always at the same time (in most cases about two weeks) after the beginning of the last menstrual flow. In 13 cases there was a variation of two days, in 4 cases there was a variation of four days, and in 2 cases of irregular menstruation it would appear on a certain day before the menstruation. In 37 out of 41 cases the pain appeared from twelve to sixteen days after the beginning of the last menstruation and in 20 of them it began exactly on the fourteenth day. In 2 cases it came from the seventh to the tenth days, in 1 case on the seventeenth day, and in 2 cases on the eighteenth day. Observations like these well support the view now generally held that this periodically returning pain, often alternating in the right and left side from month to month, is actually caused by the enlarged graafian follicle at the time of ovulation. It seems plausible that under certain conditions this process might be associated with pain.

Endocrine disturbance is probably a large factor in the conditions which cause ovulation to be painful. This pain in the mid-interval ("Mittelschmerz"), often accompanied with a slight show of blood ("spotting"), is probably more common than we realize, for Papanicolaou found microscopic blood in about 25 per cent of women examined at the ovulation time. This, as well as the pain, is probably due to the temporary drop in estrin and inadequate progesterone secretion to prevent a little blood loss. As the progesterone and estrone levels increase with the maturing corpus luteum the bleeding and pain stop. This would indicate the administration of progesterone and estrone as the painful time approaches. Pelvic heat is a helpful adjunct to any other treatment during the pain.

Radiation has been used successfully, both x-ray and radium. In persistent cases Keene used 100-200 mg. hr. of radium and in so doing he obtained the double benefit of dilatation and mild radiation effect on the ovaries. The x-ray is given to the pituitary region and men using it claim excellent results. The pituitary has so many important functions and the effect of x-ray is so little understood that pituitary radiation should be reserved as a final measure.

MENSTRUAL PRURITUS

Menstrual itching and irritation about the vulvar and anal areas may be due (1) to congestive aggravation of some continuing skin lesion such as acne or eczema, (2) to herpes or fungus infection appearing at that time, (3) to allergic reaction to pad material or powder or soap or other article used locally, (4) to local reaction to special medicine or food, or (5) to allergic reaction of the patient to her own menstrual blood. Wilson (1943) presents an instructive review of this subject.

CHAPTER XV

Disturbances of Function

STERILITY AND SEXUAL DISTURBANCES

The disturbances belonging in this chapter will be taken up in the following order:

> Sterility.
> Contraception.
> Sterilization.
> Dyspareunia.
> Sexual Frigidity.
> Sexual Hyperesthesia.

STERILITY

The question of sterility is one of increasing importance, socially as well as medically. The estimates by different authorities of involuntary sterile marriages vary from one in ten to one in six. In recent years the heretofore underestimated male responsibility has been emphasized. This percentage ranges from 30 per cent in some series to 48 per cent in others. Only a small number of cases show a single lesion which can be held entirely responsible for the sterility. Usually there is a combination of lesions in the wife or husband or both, any one of which would probably not render the couple sterile; but their combined influence is enough to bring about that result. However, an occasional case presents two or more lesions, any one of which could cause sterility. The problem of therapy in such a case hinges on the question as to which lesion carries the chief responsibility for the sterile union. Endocrine disturbance and deficiencies in diet have been shown to be definite factors in certain cases. Absence of lytic power in the semen and abnormalities of the sperm have been found to be more important than heretofore realized.

It is the purpose here to give a comprehensive and systematic method of investigating and treating the sterile couple. On account of limited space only essential items can be considered, and the statements concerning these must be concise and limited to points of diagnostic or therapeutic importance.

Causes

In order to assist in determining the exact cause of the sterility in the various cases, it is well to consider what is necessary that a normal pregnancy may take place. It is necessary ordinarily (a) that healthy spermatozoa be deposited in the vagina, (b) that the spermatozoa remain healthy and pene-

trate into the uterine cavity and into the fallopian tubes, (c) that a healthy ovum be formed in the ovary, (d) that it find its way into the fallopian tube, where it can be fertilized by a spermatozoon, (e) that the fertilized ovum pass into the uterus, and (f) that it find there an endometrium suitable for its implantation and development.

Some of these conditions are not always absolutely necessary. At least five cases of conception, with labor at term, have taken place in patients where both fallopian tubes and presumably both the ovaries were removed. Of course, some ovarian tissue was left. When a tube is removed by the ordinary technique, the tube end at the uterus may reopen and permit the ovum to pass. Fritsch ligated both fallopian tubes in the middle with silk and still pregnancy followed three years later. Ashton reported the occurrence of pregnancy in the cervix following the removal of the body of the uterus for fibromyomata, showing that even the body of the uterus was not absolutely essential to pregnancy. Again, pregnancy has occurred in cases where penetration of the male organ into the vagina was impossible, showing that the spermatozoa may pass from the external genitals up to the uterus. But these are all very exceptional cases. Ordinarily each of the conditions mentioned is a bar to pregnancy.

Assuming that the husband furnishes healthy spermatozon, the sterility may be due to the following causes:

1. *Some Conditions Interfering With Coitus.*—These conditions are considered under "dyspareunia."

2. *Laceration of Pelvic Floor.*—When there has been a marked laceration, the vagina may be so relaxed and patulous that the semen is not retained in contact with the cervix long enough for the spermatozon to pass up into the uterine cavity.

3. *Vaginitis or Profuse Discharge in the Vagina* may interfere chemically with the vitality of the spermatozon or mechanically with their progress to, or entrance into, the cervix uteri. In either case the chance of pregnancy is diminished.

4. *Some Obstruction in the Cervical Canal.*—a. Stenosis of the external os may be found in the form of the congenital "pinhole" os, or it may be due to scar tissue resulting from former injuries.

b. Stenosis at the internal os may be due to scar tissue, but it is more frequently due to a sharp anteflexion of the cervix. It is often combined with a long pointed cervix and the "pinhole" os already mentioned. This combination is a frequent cause of sterility in women who have never been pregnant, and it is usually accompanied with dysmenorrhea.

It is a question, however, how much of the benefit from dilatation is due to overcoming the stenosis and how much to the reflex stimulation of the pituitary, as mentioned under Treatment.

c. Discharge. There may be in the cervical canal an excessive secretion which interferes with the upward journey of the spermatozon. It has also been shown lately that acidity of the normally alkaline uterine mucus quickly destroys the spermatozoa and thus may be the cause of sterility.

5. *Some Displacement of the Uterus.*—a. Retrodisplacement. Retrodisplacement of the uterus may throw the cervix so far forward that the spermatozoa do not readily enter it.

b. Anteflexion. Sharp anteflexion of the cervix may also throw the cervical opening too far forward.

c. Decided Prolapse. Prolapse of the uterus may interfere mechanically with coitus or with the passage of the spermatozoa to the interior of the uterus.

6. *Some Abnormal Condition Within the Uterine Cavity* which interferes with the passage of the spermatozoa to the tubes or with the endometrium as a place for the implantation and nourishment of the fertilized ovum.

a. Hyperplasia of Endometrium.

b. Infected Endometritis.

c. Tuberculosis of the Endometrium.

d. Malignant disease (Carcinoma or Sarcoma).

e. Fibromyoma.

7. *Some Affection of the Fallopian Tubes* which interferes with the entrance of the spermatozoa into the tube or with the entrance of the ovum into the tube or with the passage of the fertilized ovum from the tube into the uterus.

a. Inflammation. Inflammation of the tube is the most frequent cause of sterility from tubal disturbance. This may be very slight—not enough to produce symptoms or physical signs, but just enough to cause occlusion of one or both ends of the tube. It may vary all the way from this mild form to severe inflammation and disorganization of the tube, with extensive exudate and adhesions and abscess formation. Salpingitis, coming on after the first childbirth or miscarriage, because of inflammation during the puerperium or because of gonorrheal infection brought by the husband who was untrue to his wife during her confinement, is a prolific source of the so-called "one child sterility."

Von Mikulicz-Radecki found that appendicitis with involvement of the tube and ovary was responsible in 14 per cent of the sterility cases in his care, and he ranks this factor third among the causes of sterility.

b. Tuberculosis of tubes and adjacent structures.

c. Tumor. A tumor of the tube or in the vicinity may interfere seriously with the lumen and function of the tube.

d. Malformation of the tubes. This may consist in atresia of one or both ends of the tubes, or in blind passages and diverticula into which the ovum may wander and lodge. Or there may be abnormal openings in the wall of the tube through which the ovum may pass out into the peritoneal cavity and be lost.

8. *Some Affection of the Ovaries* that interferes with their function to such an extent that healthy ova are not formed or are not discharged in such a way that they pass into the fallopian tubes.

a. Inflammation.—Inflammation of the ovary may be present in some of its various forms—infected oophoritis, simple oophoritis, cystic ovary, cirrhotic ovary, or an ovary with exudate and adhesions.

b. Tuberculosis of ovaries and vicinity.

c. Tumors of the ovary.

d. Displacement of the ovary may be so marked that the ova, instead of passing into a fallopian tube, where they would be fertilized, pass into the peritoneal cavity and perish.

9. *Certain Operations*—for example, removal of the uterus or of the fallopian tubes or of both ovaries, or radiation treatment sufficient to stop menstruation.

10. *Douches*, which may interfere chemically or mechanically with the process of impregnation.

11. *General Conditions.*—The general health may be so poor that all the organs of the body are in too poor a condition to functionate properly, the genital organs among them. This is seen in some cases of marked anemia and emaciation and general depression. On the other hand, it is present at times in patients who are inclined to stoutness. The effect of obesity in diminishing menstruation has been mentioned, and it sometimes has much the same effect on the capacity for impregnation. It has happened that sterility came on when a patient accumulated fat and disappeared promptly on reduction to her usual weight. That an insufficient diet may have an influence toward sterility has been shown experimentally by Reynolds and Macomber.

12. *Endocrine Disturbances* have a marked influence on the function of the ovaries and the uterus, and hence must be considered in all cases of persistent sterility.

Plan of Investigation

Outline of steps to be followed in the investigation of a sterile couple:

```
                                Wife.
                              /
                   General
                 /           \
               /               Husband.
  I. History                 Wife.
               \            /
                 Sexual
                          \
                            Husband.
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                 General—Wife.  If any special indications, refer hus-
               /                            band for general examination.
  II. Examination
               \                 Vaginal.
                 \             /
                  Special
                          \
                            Laboratory tests.
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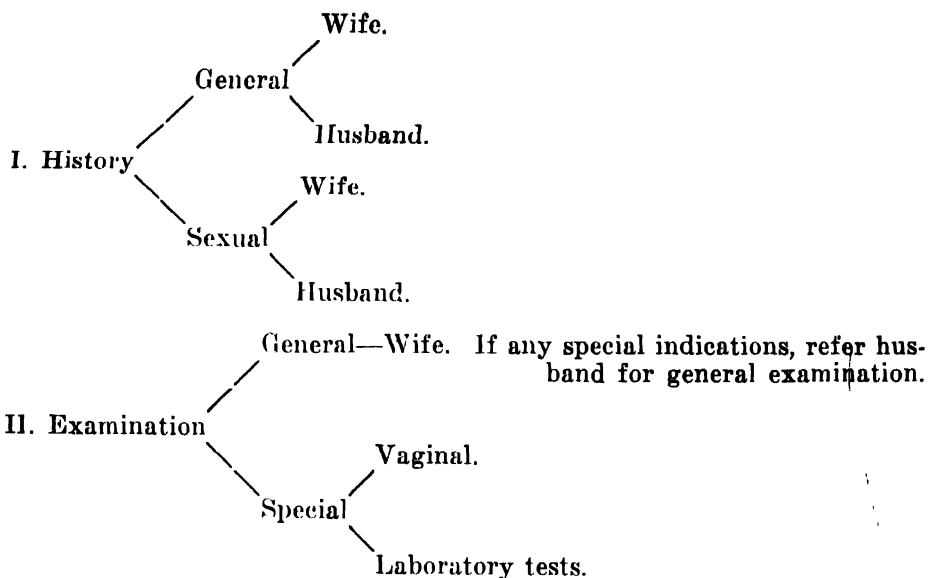
III. Huehner or postcoital test, with examination of sperm.

IV. Examination of condom specimen, with complete examination of sperm.

V. Gas test for tubal patency.

VI. Lipiodol test.

VII. Complete endocrinologic examination of husband and wife, with any special tests that are needed.

VIII. Test of treatment.

The steps of this plan are followed ordinarily in the order given. After Steps I and II, if no causative lesion is found, the patient is usually started on a course of treatment to increase ovarian activity and to overcome any minor local disturbance present, such as discharge or overacidity. The additional examination methods are employed subsequently, step by step, if and when the necessity for each appears.

HISTORY.—The general history should follow the form outlined in Chapter II and should include the following points of special interest:

FAMILY HISTORY.—History of fertility, age at onset of menses and of climacteric in the grandmother, mother, and sisters. Definite endocrine disturbances in the family, familial diseases.

PAST HISTORY.—Childhood diseases, especially mumps with any subsequent complications; tuberculosis; venereal diseases. Severe infections or illnesses; heart, kidney, lung, or gastrointestinal trouble. Operations, with a statement as to what was done and whether or not x-ray or radium was used. Occupation, including hours of work and type of work. Habits, especially use of alcohol, tobacco, and drugs. Social activities, including recreation, exercise, hours of sleep. Any gain or loss of weight should be noted.

MENSTRUAL HISTORY.—Age at onset, skipped periods, delayed periods, scant or profuse periods, date and character of last two periods, vaginal discharge, mental reaction with menses.

MARITAL HISTORY.—Age at marriage and ages at which children were born. Complications with pregnancy or delivery and postpartum course. Miscarriages or abortions with sequelae. Were the children breast fed and, if so, how long? When did the menses return? General health of husband, including height and weight; occupation, with hours of work, exercise, habits.

PRESENT ILLNESS.—How long has involuntary sterility existed, and is it primary or secondary? Is contraception practiced? Why? What form? How long has it been used? Has the patient any idea as to the cause of sterility?

The sexual history is seldom mentioned by the patient; but, by tactful questioning, she usually welcomes the opportunity of discussing the subject concerning which she had heretofore been reticent.

COITUS.—Method, frequency, pain, vaginismus; does penetration occur? Reaction: satisfaction, disgust, submission. Does semen remain in vagina or is it lost? Masturbation or other habits? Is a douche taken before or after coitus?

ENDOCRINE DISTURBANCES.—Many disturbances in the sexual life of a patient have an endocrine basis. There is much overlapping of symptoms due to the close relationship of all the endocrine glands, and it is not always possible to classify all the symptoms under one organ. A general outline of symptoms, classified under the various incretory glands, is here given.

Ovarian: Regularity of menses, amenorrhea, dysmenorrhea, metrorrhagia, scant or excessive flow, response to coitus, mental outlook, periods of wellbeing or sex desire, no desire, excessive desire or nymphomania, climacteric symptoms.

Thyroid: Exophthalmos, tremor, tumor of neck, palpitation, loss of weight, excitability, slightly elevated or depressed temperature, myxedema, periods of depression, obstipation, sleepiness, gain in weight, lassitude, lack of perspiration, scalp dry, prematurely gray, thinning of outer end of eyebrows, brittle hair which falls out easily, nails brittle and striated, loss of sex desire, cold hands and feet. As the function of the thyroid affects the ovarian function, symptoms listed under ovary are usually present.

Pituitary Gland: Gain of weight, increase or decrease of sexual desire, change in menses, bitemporal headache, sleepiness, hypertrichosis, polyuria, visual disturbances.

Adrenal Gland: Asthenia, loss of weight, diarrhea, pigmentation of skin, hypertrichosis, virilism, precocity.

General Examination.—In the general examination give special attention to the following points:

GENERAL.—Habitus or type—masculine, feminine, neuter, infantile. Distribution of hair and fat. Development of secondary sex characteristics, bony skeleton, voice, and gait.

ENDOCRINE.—Points to be noted are classified under the different glands.

Ovary: Development of sex characteristics, size of uterus, size of clitoris.

Thyroid: Size and shape of gland, consistency of gland, blood pressure, pulse, lid lag, palpebral fissure, bruit over gland, size and condition of heart, tremor of fingers, condition of skin, edema of myxedema, mental alertness, general muscle tone.

Pituitary: Fat distribution and weight; distribution of hair; size of jaw, hands, feet, and long bones; spacing of teeth; x-ray of sella turcica; carbohydrate test; Fröhlich's syndrome; amount of urine, glycosuria.

Adrenal: Virilism, hair distribution, pigmentation, blood pressure, blood sugar, sugar in urine.

Pelvic Examination.—The special points to be noted in the vaginal examination are: size of opening, size of clitoris, adhesions about clitoris, pain on examination. Distribution of hair (escutcheon), reaction of vaginal and cervical secretion, discharge (type). Position, size, and condition of cervix; size of os. Notice whether the cervical plug is present. Note the usual seven points about the uterus, especially position and size. Usual examination of adnexal areas.

Laboratory Tests.—There may be certain disturbances requiring one or more of the following laboratory procedures:

Complete Blood Test: R.B.C., W.B.C., differential count, Wassermann test.

Hormone Tests (urine and blood).

Basal Metabolism: If thyroid disturbance is suspected.

X-Ray: Long bones, jaw, and sella turcica where pituitary disturbance is suspected. Gastrointestinal x-ray, gallbladder function test, or x-ray of teeth when focal infection is suspected.

Sugar Tolerance Test: In pituitary cases.

Huehner or Postcoital Test.—Direct patient to lie on her back for one-half hour after coitus; then come to office immediately. Semen is then collected with a dry pipette from the following three areas for examination: posterior fornix, around cervical plug, and with the plug removed some of the fluid in the cervical canal is aspirated. The fresh specimens are then examined microscopically. If there are numerous very active sperms from all three locations which maintain their motility for two or three hours and show no morphologic abnormalities in the stained specimen, the husband may be considered fertile. If normal sperms are found only in the specimen from the posterior fornix, the action of the sperm on the cervical plug must be tested (see below). If the sperms are dead in the posterior fornix specimen, the reaction of the vaginal secretion must be determined and the viability of the sperm tested. If the sperms are few in number, slow moving, or show some morphologic abnormality (Fig. 1080), then the condom test should be employed.
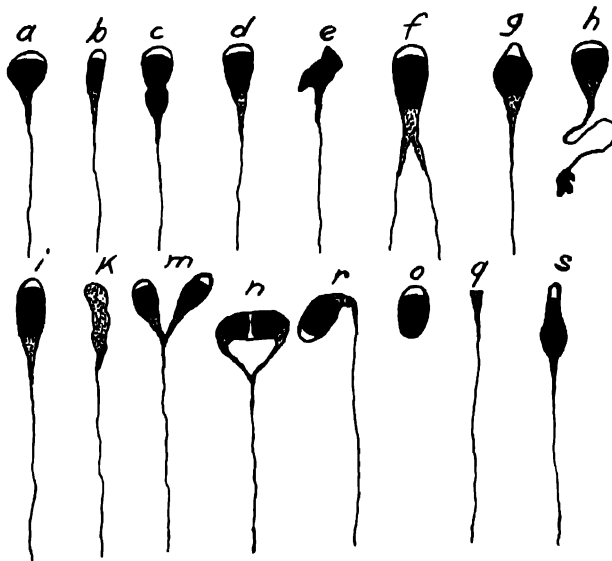
Fig. 1080.—Forms of spermatozoa. Tails shown relatively shortened *i*, represents an average normal sperm, the head measuring 3 by 5 microns and the tail measuring 55 microns in length; *s*, shows a side view; *a, b, c, d, g*, variations in size of the sperm; *e* and *k*, degenerated forms; *f*, double tail; *m* and *n*, double head; *h*, a shortened tail; *o* and *q*, head broken from the tail. (Mason—*Am. J. Obst. and Gynec.*)

Examination of Condom Specimen.—To secure material for this examination have the husband wear a condom during intercourse; or, if he refuses to do this, have the wife aspirate the semen immediately after it is deposited. A bulb syringe with a piece of rubber tubing about four inches long attached to its end is handy for this purpose. The specimen is collected and the tubing is then folded back along the barrel of the syringe and held there by a rubber band. No special precautions are necessary to keep the specimen warm unless the weather is exceptionally cold, in which case it can be carried under the dress next to the body. Sperms live from twenty-four to sixty hours at ordinary temperatures; and, if dead on arrival, the trouble is probably the sperm.

Points to be noted are as follows:

1. *Gross.*—Amount usually 4-6 c.c.; consistency is that of thin starch.

2. *Microscopic.*—The fresh specimen is examined first. The motility of the sperm should be active and "purposeful." With 450 magnification sperm should travel about one-half the diameter of the field in four minutes. A rough idea of the normal number per

field can be obtained only by observing numerous normal specimens. Any marked abnormalities are noted. Longevity of the sperm varies a good deal. Mason found that abnormal forms live longer than normal ones. These abnormal forms were present in couples where there were frequent abortions.

If the sperms are sluggish, change direction frequently, swim in wide arcs or live less than three hours in a hanging drop, they are probably deficient and a stained preparation should be made.

For the stained smear Moench's technique is very satisfactory. A mixture of ⅔ Ziehl-Neelsen's carbolfuchsin and ⅓ concentrated alcoholic eosin (bluish) solution is filtered, and to the finished mixture is added ⅛ of 95 per cent alcohol. For the counterstain add 2 parts of distilled water to Loeffler's methylene blue. This stains the head of the sperm blue and the tail pink. An even smear is made on a clean slide, dried in the air, and fixed by heat. This is then treated with 1 per cent chlorazene to remove the mucus. The slide is then washed with water and 95 per cent alcohol. It is then stained for four and a half minutes, washed with water, and counterstained for four or five seconds.

3. *Lytic Power of Semen.*—If the motility and morphology of the sperm are normal, but few or none are found in the specimen removed from the cervical canal above the mucous plug, or if the mucous plug seems to be unusually large or tenacious, the lytic power of the semen on the mucous plug should be tested. The following method advocated by Kurzok and Miller is simple and accurate. Instruct the patient to take no douche for two days prior to her visit to the office. Have her bring a condom specimen which is not older than six hours. After cleansing the vagina and cervix around the external os, the cervical plug is removed with a sterile uterine dressing forceps and dropped into a test tube containing 2 c.c. of distilled water plus 0.5 c.c. of semen. This is incubated for twenty-four hours at 37.5° C. If the semen has normal lytic power, within half an hour the mucus loses its glossy, gelatinous appearance and becomes dull, hazy, and frayed; and in from twelve to twenty-four hours it should be entirely gone. Sometimes a slight film remains, but this disappears on shaking the tube.

Gas Test for Tubal Patency.—This test is completely discussed in Chapter II, including indications, contraindications, and technique.

Lipiodol or Neo-iopax Test.—When the gas test shows the tubes blocked, the exact location of the block can be determined by the neo-iopax test. This test is fully discussed in Chapter II.

Endocrinologic Investigation.—In obscure cases in which no definite trouble can be found and also in patients showing evident endocrine disturbance, special tests, such as basal metabolism and others mentioned under Endocrine Examination, should be carried out.

In this connection, the examination of vaginal smears will show whether the vaginal contents are normal or of the hormone-deficiency type. Also, such examination is helpful in determining whether the endocrine treatment being given is really effective. Vaginal smears plus rectal temperatures, as suggested by Rubenstein, assist in determining the time of ovulation.

Endometrial biopsy in the proper time-relation will show whether or not the patient is ovulating.

Test of Treatment.—In certain cases it is impossible to discover the exact etiology of the sterility. In these cases conservative treatment as outlined below should be tried.

Treatment

The treatment may be divided into the general treatment, which all sterility patients are to be given, and the special treatment for special indications.

General Treatment.—The diet given should be balanced and contain a high content of *vitamin E*, which aids fertility. Vitamin E is found in butter, wheat germ oil, meat, whole wheat, rolled oats, milk, spinach, and lettuce. Foods cooked in lard should not be used as the lard tends to oxidize the vitamin E, nullifying its effect. Cod liver oil has the same effect, consequently should not

be used during treatment. Concentrated vitamin E can be given in one of the forms prepared by the reliable drug firms. If the patient is overweight, a reducing diet should be given; and if underweight, a building-up diet is prescribed.

Endocrine Treatment.—The vitamin and nutritional requirements having been taken care of and there being no obvious local lesion, endocrine treatment is to be considered.

Hypothyroidism ranks high as a cause of sterility, particularly in private practice. Winkelstein in a study of a group of normal and hypothyroid sterility cases, concluded that thyroid is of great value in sterility if the patient is a definite hypothyroid but that in sterility cases with normal thyroid function thyroid medication is of no value. However, it is sometimes difficult to be certain whether or not a patient has mild hypothyroidism, and it is a good plan to give all sterility patients a test of thyroid therapy unless the basal metabolism is definitely elevated.

Disturbances in the pituitary-ovarian endocrine cycle may lead to cessation of ovulation, intermittently or over a long period. The incidence of **anovulatory sterility** varies in different reported series. Rock and his co-workers report 9 per cent in an unselected group of sterility cases, while Mazer and associates report 30 per cent in a group of sterility cases selected because there was no accountable cause for the sterility.

In the treatment of anovulatory sterility, indicated when the endometrial biopsy shows no evidence of corpus luteum formation, an attempt is made to imitate the normal menstrual cycle by giving ovarian and pituitary hormones in the following time-relation.

An *estrogenic hormone* is given by mouth throughout the first twenty-six days and then it is stopped. *Pituitary preparations* or *pregnant mare's serum* are given from the fifth to the fourteenth day. The new combination of the pituitary synergist and the urinary hormone, if used, should be given during this same time in the cycle. During the last twelve to fourteen days of the cycle five milligrams of progesterone are given daily as intramuscular injections. It is well to supplement this program with *thyroid medication*, as previously mentioned. If the basal metabolic rate is a little low, or even within normal limits, small doses of thyroid, ¼ to 1 gr. daily, should be tried.

When the endometrium shows that ovulation has occurred but that the progestational changes are not complete, the pituitary hormones need not be given but the ovarian hormones are given in the same sequence as outlined above.

Though the question as to whether pregnant mare's serum causes ovulation in non-ovulatory sterility is still unsettled; the fact that many patients, who have had a sterility resistant to other forms of therapy including endocrine therapy, become pregnant cannot be denied. We have had to date four very obstinate cases of long-standing sterility in our own practice. After other sterility factors had been ruled out and the usual endocrine therapy had been tried without result, they conceived after several series of gonadogen injections. Hall reported that 55.8 per cent of 43 sterility cases, in whom other causes had been ruled out, became pregnant after the use of pregnant mare's serum.

Recently a combination of pituitary hormone and the urinary gonadotropic hormone, called synapoidin (Parke, Davis and Company), has been used to promote ovulation. It is still too early to judge its effectiveness.

Other Measures.—If the patient is fat or sedentary, exercise each day is prescribed. If the patient is using up most of her energy working, a rest of an hour each day is advised, with a vacation if possible. A vacation is of decided benefit in cases where social responsibilities, with late hours, etc., are undermining the patient's general health. Sunlight and ultraviolet light help to improve the general health.

Alcohol and tobacco should be limited or prohibited, as experimental work has shown them to be definitely detrimental to fertility. This limitation ap-

plies to the husband as well as to the wife. Dr. Lyle Phillip of Honolulu, in a personal communication, reports an interesting case of sterility due to excessive cigarette smoking by the husband. The Huehner test showed normal-appearing spermatozoa and in normal number, but there was no motility. The test tube specimen gave similar findings. On discontinuing smoking, the spermatozoa became normal and the wife conceived. The test was carried out several times, and each time that the husband smoked heavily the spermatozoa became immotile, and after a few weeks of abstinence they would regain normal motility.

In obstinate cases of sterility patients may be advised to occupy separate beds, with periods of coitus only every two to four weeks. The period of rest increases the chance of conception. Edgar Allen and associates have removed the ovum from the tube on the twelfth day after menstruation, which means that from the twelfth to the fourteenth day is probably when ovulation takes place. The most likely time for conception is from about the tenth to the eighteenth day after the period.
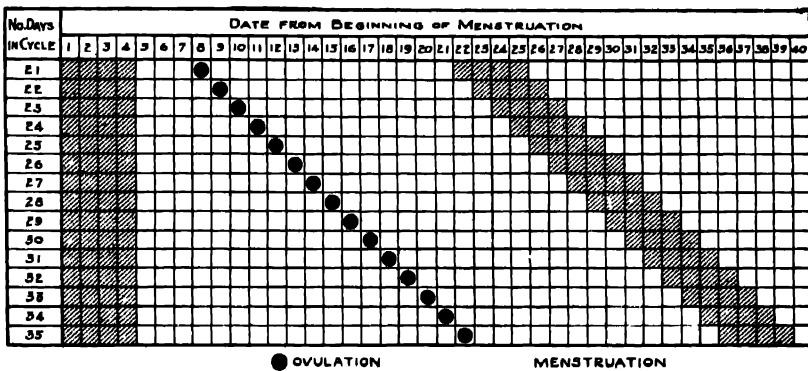
Fig. 1081.—Ovulation date for various cycles. (Miller—*Surg., Gynec. & Obst.*)

A. G. Miller made a five-year study of the fertile period in practice, and worked out that period for menstrual cycles of different lengths. Figs. 1081, 1082, and 1083 are from his article. The first shows how the day of ovulation varies with the different cycles, the second indicates the fertile period for each cycle, and the third demonstrates how attention to this item overcame sterility in a patient married eight years without a pregnancy. These tables are useful also in determining the period of least fertility in the different cycles—the so-called "safe periods," mentioned later. Intercourse should not be limited to the fertile periods, however, as records show that pregnancy may result from isolated coitus at any time.

The knee-chest position after coitus may be tried. This throws the mouth of the uterus into the seminal pool.

The effect of an alkaline douche on the Huehner test and sterility was shown to be very beneficial by Singleton and Hunter. An alkaline douche before retiring is especially helpful where the vaginal reaction is strongly acid or where the sperm cannot resist even weak acid secretion. If the reaction is strongly alkaline, a 0.5 per cent lactic acid douche helps to establish the normal reaction of the vagina.

In cases in which the husband has active sperms but none are found in the cervical canal—that is, something about the cervical secretion renders the spermatozoa inactive—coitus during menstruation may be tried. The menstrual blood, according to Hoehne, is an especially favorable medium for persistence of the activity of spermatozoa; and Dickinson found that of recorded pregnancies from isolated coitus a considerable proportion resulted from coitus during menstruation. Rubenstein reported six cases of pregnancy following isolated coitus during menstruation.

Diathermy, by improving pelvic circulation, tends to improve ovarian function and thereby increases the chance for conception.
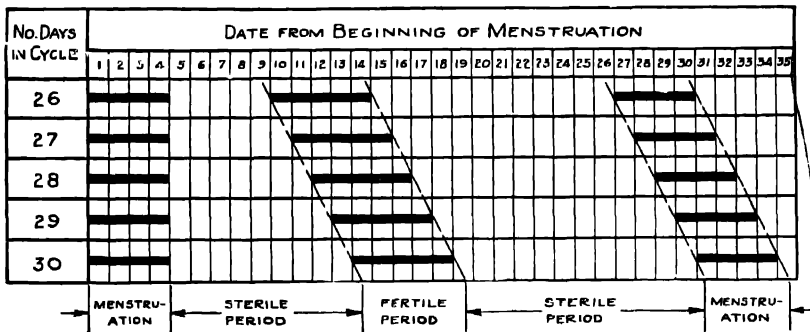
Fig. 1082.—Fertile period for various cycles. (Miller—*Surg., Gynec. & Obst.*)
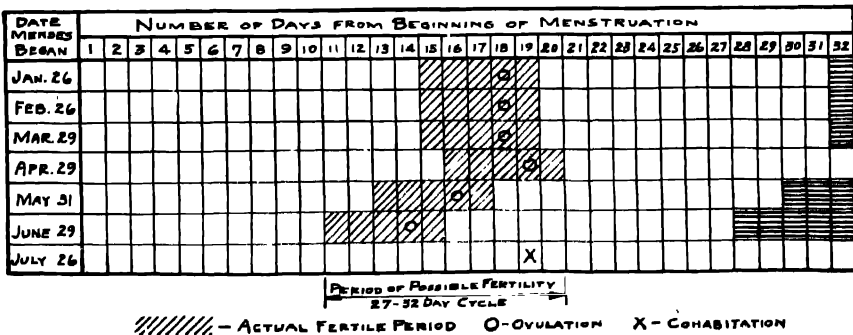
Fig. 1083.—Data in the case of a patient who came for sterility treatment, having been married eight years and no pregnancy. Pregnancy was secured promptly by strict attention to her fertile period. (Miller—*Surg., Gynec. & Obst.*)

X-ray and radium are indicated in selected cases where the periods are irregular. Kaplan in a series of 128 patients with amenorrhea and sterility treated by x-ray radiation of the ovary and in some cases to the pituitary area also, had 44 patients become pregnant. Thirty-six of these patients went to term, giving birth to 47 living children, one stillbirth and one abnormal fetus. Nine of these women had more than one child and there was one set of twins. Of the 44 pregnant patients amenorrhea had existed one month to fourteen years and sterility from one to eighteen years. The oldest child at the time of the report was 10½ years and there were no reports of any harmful effects on any of the surviving children.

Special Treatment of Lesions.- The special treatment required depends on the particular lesions found.

VAGINISMUS.- In some cases this is due to fear or to some inhibition carried over from childhood experience or teachings. In these cases a frank explanation of the natural instinct for coitus will do much to remove mental obstacles. Any stenosis or other congenital abnormality, such as double vagina or septate vagina, should be corrected. If intercourse is painful with a good-sized opening, free use of a lubricating jelly should be advised; and, if still painful, the cause of the pain must be determined and corrected. If the condition is due to a small opening or a rigid hymen, this should be stretched gradually; and, if this is unsuccessful, a plastic operation may be done to enlarge the opening.

VAGINITIS. -The treatment of this condition consists of a course of antiseptic and soothing applications and regular douches, such, for example, as a 5 per cent mercurochrome application once a week in conjunction with daily douches of 0.5 per cent lactic acid. This plan of treatment usually clears up the discharge and establishes the normal vaginal flora.

CERVICITIS.—Linear cautery treatment combined with the dry treatment will usually clear up the cervicitis. Diathermy is helpful in obstinate cases. If after a trial of conservative treatment the condition persists, conization of the cervix is advisable.

STENOSIS OF THE INTERNAL OS.- If this condition is mild, office dilatations usually suffice. If, however, the condition persists in spite of these treatments, thorough dilatation and insertion of a stem pessary are indicated. If the trouble returns in a short time, the Dudley operation will usually give permanent relief from the obstructive feature.

The beneficial effect of cervix dilatation in sterility cases may be due as much to reflex stimulation of pituitary function as to overcoming stenosis. Birnberg found a positive prolan response in the urine in 23 out of 30 sterile women in thirty hours following gradual dilatation of the cervix. All had had negative response before the dilatation. Those showing prolan response, later conceived. Birnberg feels that the beneficial action of the dilatation is due to stimulation of the pituitary gland by way of the sympathetic nerve pathway.

ENDOMETRIAL CONDITIONS.- Hyperplasia of the endometrium with excess menstrual flow may be present. Occasionally, chronic cervicitis is accompanied with a chronic metritis. In either case, curettage is beneficial in that it removes the diseased endometrium, giving a chance for a better one to develop under bettered conditions. Curettage is a stimulant to the uterine circulation and nutrition, and for that reason is indicated in sterility cases which resist other measures. Also, if simple dilatation of the cervix causes reflex stimulation of the pituitary function, curettage would probably have a more pronounced effect in that direction.

DISPLACEMENTS OF THE UTERUS.— Anteflexion of the uterus requires the treatment outlined under Stenosis of the Internal Os. Retrodisplacement, though not as important as formerly supposed, if marked, may cause sterility. Pessary treatment should be tried, combined with the knee-chest posture. If this proves unsuccessful and a study of conditions shows operation necessary, care should be taken to select the type of operation best suited to the individual case.

Prolapse during the childbearing period can be effectively corrected either by vaginal or by abdominal operation in such a way that it does not interfere seriously with delivery. Any anomaly of the uterus should be corrected.

CLOSED TUBES.—If the gas test shows the tubes closed, the sites of closure should be determined by lipiodol visualization and the conditions carefully studied before resorting to any operative procedure. In the best hands salpingostomy is successful in only 10 per cent of the cases, and in the successful cases there is a high percentage of abortions and ectopic pregnancies.

OVARIAN LESIONS.—Large cysts should be removed. When the outer portion of the ovary is thickened by an old inflammatory process which prevents ovulation, peeling off of the superficial layer so that the follicles can rupture may render the patient fertile. The authors had a striking case of this kind.

In some cases of long-standing endocrine disorder, the resulting cystic condition of the ovaries becomes so marked that operative treatment is required to overcome the structural interference with ovulation. Leventhal reported the details of such a case, and gave instructive illustrations concerning the diagnosis.

Artificial Insemination

In a case where the healthy spermatozoa fail to reach the uterine cavity in spite of the various treatment measures, artificial insemination may be employed. Careful precautions must be taken to avoid contamination of the semen that might lead to infection inside the uterus. Also, care must be exercised to avoid interfering with the vitality of the implanted spermatozoa.

In cases where the husband has no sperm and treatment is of no avail, the question of artificial insemination with selected semen arises. In some cases the partners of the sterile union are anxious to have the child at least partly theirs rather than adopting one of doubtful parentage. The donor is selected by the physician after a most careful history and physical tests, including of course blood tests. It is well to use two donors, so that no one can possibly know who is the father of the child. The actual procedure must be done at the supposed time of ovulation and under rigid aseptic technique.

Seymour has an interesting article on the use of this method, and in the same journal there is an excellent editorial on the legal aspects of the procedure and the legal status of the child (J. A. M. A. 112: 1832, 1939). Seymour and Koerner in 1936 discussed the medicolegal features and presented a legal form which they have signed by husband and wife, after which the finger-prints of each are affixed to the document. In 1941 the same authors presented the results of a questionnaire to 30,000 physicians in the United States. There were 10,604 reported cases of sterility treated by artificial insemination, with more than 9,000 women attaining motherhood through the method. After special consideration of various items, they give a summary about as follows:

Of nearly ten thousand pregnancies that were obtained through artificial insemination, two-thirds were effected through utilization of the husband's semen alone.

The proportion of boys to girls resulting was roughly 8 to 5 when the husband's semen was used and 7 to 5 when a donor's was used.

Ninety-seven per cent of pregnancies initiated by artificial insemination resulted in live babies.

The incidence of miscarriages and abortions was only one-fifth that occurring normally in the population taken as a whole in areas where artificial insemination is not practiced.

The incidence of extrauterine pregnancies was only one-sixth that occurring normally.

The occurrence of stillbirths was practically negligible.

"Flare-ups" from uterosalpingography were few and were mostly of a transitory nature.

All living children were born normal in every respect.

Successful pregnancies were reported with inseminations varying in number from one to seventy-two. Forty-five per cent of all pregnancies occurred in cases in which twelve inseminations were employed. In three hundred and sixty-five cases more than twenty inseminations each were required to secure a pregnancy.

One thousand, three hundred and fifty-seven had repeated pregnancies by artificial insemination.

One thousand, one hundred and fifteen failures were reported in the survey. The principal causes of failure can be removed if inadequate preliminary study of the case, lack of cooperation of the patient, unreliable messengers, the use of imperfect seminal specimens and the lack of perseverance on the part of the physician in his attempts at insemination are eradicated.

CONTRACEPTION

In cases needing contraceptive advice, the question arises as to what method to advise. In the extensive experience of the large clinics of the country the contraceptive diaphragm and the contraceptive jelly have given the best results, from both the standpoint of safety and of satisfactory response.

The size of diaphragm to be used is determined by trying the various sizes of measuring rings. The largest one that fits snugly when the posterior rim is in the posterior fornix is the one to use. The patient should be instructed in the use of the diaphragm, and it is best to have her insert it and remove it, so that there is no doubt as to her knowledge of its use, because to be successful the method must be correctly used.

In cases of retrodisplacement, an inserter is sometimes needed to enable the patient to get the inner end of the diaphragm across and behind the cervix. In cases of cystocele, the matrisalus type of diaphragm must be used.

The patient is instructed to use the contraceptive jelly around the rim of the diaphragm, and also to place some on the cervical surface of the diaphragm.

A condom used by the husband in combination with a contraceptive jelly used by the wife is also very successful but not quite as convenient as the diaphragm method.

Catholic patients who do not wish the diaphragm or condom methods may be instructed in the use of the "safe period," but it should be explained that this method is only relatively safe. Ogino and Knaus have shown that eight days after the onset of the period and eight days before the onset of the next period are relatively safe in women with regular twenty-eight day cycles.

The "safe period" varies with the type of the menstrual cycle. The details of these variations in relation to sterility and contraception are helpfully discussed by A. G. Miller in the article previously referred to and from which Figs. 1081 to 1083 were taken.

STERILIZATION

In certain cases there are serious medical conditions contraindicating pregnancy. In these, sterilization may be indicated. The first question to be decided in these cases is which of the partners should be sterilized. The operation in the male (ligation of the vas deferens) can be done under local anesthesia with little risk to the patient. The effective methods in the woman require either an abdominal operation or extensive vaginal work with entrance to the abdominal cavity and either of these procedures carries considerable risk, to say nothing of the discomfort and disability they cause. These questions and the problems of future events should all be discussed with the patient and her husband and the method selected which applies best in the particular case.

The use of diathermy to cause stricture of the uterine end of the fallopian tubes is as yet too new to judge as to its reliability.

DYSPAREUNIA

The two principal disturbances of sexual intercourse are dyspareunia (difficulty in coitus) and sexual impotence (absence of sexual orgasm in coitus).

Difficulty in coitus (dyspareunia) varies from a slight discomfort, hardly noticeable, to pain so severe as to make coitus unbearable.

Causes

The more common causes of dyspareunia are as follows:

1. **Some Obstructions to Normal Coitus**—*A. Imperforate Hymen.*—In such a case there would be present the history of amenorrhea and also the disturbances that come from retained menstrual blood. You may think there would be a history of no coitus, and such is usually the case, but in some cases coitus has taken place through some adjacent opening—for example, through a dilated urethra.

B. Organic Stenosis of Vaginal Orifice.—The opening is large enough to permit the regular escape of menstrual blood, but it is not large enough to permit coitus. The obstructing tissue is so firm that it does not rupture as ordinarily on attempted coitus. This obstruction may be due to a very strong, firm hymen, or to some distinct malformation, such as a vaginal septum from double vagina. Usually with double vagina, each vagina is large enough for coitus or the septum is placed so far to one side that it does not interfere. But it may be so placed as to interfere decidedly with coitus and to require division. Again, an organic stenosis here may be due to scar tissue from severe burn or other injury, or from laceration in labor, with extensive scar tissue formation, or from vaginitis in childbirth.

C. Spasmodic Stenosis at Vaginal Orifice.—In some cases there is marked hyperesthesia about the vaginal orifice, and every attempt at coitus causes unbearable pain or causes spasmodic contraction of adjacent muscles to such an extent that coitus is impossible. This marked hyperesthesia may be due to inflammation, such as vulvitis or vaginitis, or it may be due to sensitive abrasions about the vaginal entrance. In other cases it is due to that peculiar condition known as "vaginismus," a reflex contraction of the levator ani and adjacent muscles without apparent cause. In exceptional cases this is so severe and persistent as to prevent coitus altogether.

D. Severe Pain on Attempted Intercourse.—There is no stenosis or spasm, but just pain, so severe that coitus is impossible. This may be due to inflammation about the external genitals or inflammation within the pelvis.

2. **Simple Inflamed Abrasions about the Vulva** are not an infrequent cause of much suffering immediately after marriage. The small abrasions that naturally accompany rupture of the hymen at the first intercourse may become inflamed after a day or two, making subsequent coitus painful. This sometimes causes much alarm to the patient and her husband, who fear some serious trouble. The treatment is abstinence from coitus for a few days, with the frequent use of some mild antiseptic wash, followed by drying with absorbent cotton and the use of a soothing ointment, such as white vaseline. It is well

to keep the parts covered with a pad of absorbent cotton, to keep the clothing from contact with the painful areas and also to protect the abrasions from infection.

3. **Venereal Sores** (chancroid, syphilitic).—These ulcers also may be found soon after marriage or at any other time. Care should always be taken not to give a positive prognosis in a case of abrasion or sore which has not yet had time to develop its characteristics.

4. **Gonorrheal Inflammation** is an altogether too common cause of painful coitus in the first few weeks following marriage. The pain may be due to the vulvar inflammation, or to the urethritis or to the vaginitis, or to painful abrasions or to the inflammation of the vulvovaginal gland of one or both sides.

5. **Other Forms of Inflammation** of vulva or vagina, or vulvovaginal glands.

6. **Inflammation of Uterus** (acute or subacute).

7. **Inflammatory Lesions around the Uterus,** in which pain is caused by the impact of the male organ or by the sexual congestion. When the ovary is prolapsed into the cul-de-sac and bound there by adhesions, sexual intercourse may cause much pain. The senior author recalls one patient in whom it was finally necessary to open the abdomen, break up the adhesions, and fasten up the prolapsed ovary in order to relieve the suffering in coitus. In the more serious pelvic inflammatory conditions, dyspareunia is frequently a prominent symptom.

8. **Retrodisplacement of the Uterus,** with inflammation. It is surprising how much displacement of the uterus, with forward projection of the cervix and apparent blocking of the vagina, can take place without occasioning any particular disturbance in coitus. But if inflammation appears, then dyspareunia is often marked—much more so than from the same amount of inflammation without displacement.

9. **Bladder or Rectal Diseases** occasionally cause painful coitus, particularly inflammatory diseases.

Treatment

The treatment of dyspareunia is indicated by the **particular condition present,** as determined by a careful examination.

1. If there is some **malformation** about the vaginal orifice (imperforate hymen, thick hymen, septum in vagina, organic stenosis of vagina), the obstruction must be removed by the necessary operative measures.

2. If coitus is interfered with by **tender areas** about the vaginal entrance, or by ulcers or by hyperesthesia, the following measures may be employed:

> a. Abstinence from sexual intercourse for from one to three weeks.
>
> b. Hot vaginal douches once or twice daily—medicated or unmedicated, depending upon the presence of discharge.
>
> c. Laxatives as needed. Chronic constipation increases the congestion and irritability of the structures.
>
> d. Some sedative ointment—for example, chloretone ointment (10 per cent), applied two or three times daily.
>
> e. Bromides, if there is much nervous irritability or apparent hyperesthesia of reflex centers.

    f. When intercourse is again attempted, the patient should coat all the sensitive surfaces with a sedative ointment. The chloretone ointment above mentioned may be used or simply plain vaseline.

3. If the vaginal opening is too small or there is the spasmodic condition known as **vaginismus,** stretching of the opening is to be employed in addition to the other measures just detailed. In some cases the tendency to spasm may be overcome by gradual stretching with a speculum every few days. Also have the patient continue the stretching at home with graduated rectal dilators.

In cases of organic narrowing or a serious grade of vaginismus that does not yield to minor measures, it is advisable to operate under anesthesia. The operation consists in incising the perineum and pelvic floor so as to enlarge the opening, and then undermining the flaps and suturing them over so as to cover the divided surfaces.

The treatment of the **other organic lesions** mentioned is taken up in detail in the appropriate chapters.

SEXUAL FRIGIDITY

The absence of strong sexual feeling in the woman during coitus does not assume the serious aspect it does in the man, with whom erection is necessary to insemination leading to pregnancy. The strong sexual feeling, with its consequent orgasm, in 'the woman is not at all necessary to impregnation, though it increases the probability of impregnation. From the history of cases of sexual disturbance it is evident that many otherwise normal women have little or no sexual feeling until some months or years after marriage—sometimes not until after one or more children are born. The response to sexual excitement apparently grows with the proper exercise of the sexual functions. This fact is important and may be used to prevent discord and disruption in families where either the husband or the wife is becoming dissatisfied and despondent because it is felt that there is not the proper sexual response.

Again, there are cases in which the wife is not in physical condition to respond. She has some chronic trouble which so saps her strength that she has not the vitality for this function. This loss of strength may be due either to some general condition or to some local condition, or to both. It is hardly necessary to name the various conditions. They comprise the whole list of debilitating conditions, both general and local.

Some patients, because of parental ignorance, have been given an erroneous conception of the part which sexual intercourse plays in married life. These patients need instructions in sexual matters and the physician's advice should be supplemented by a good book on the subject. There are many helpful books on this subject, one of the best being *Married Love* by Marie Stopes. This book deals with the mental and spiritual reactions of the union as well as the physical side and technique.

The **treatment** of sexual impotence is directed toward removing any local disease, and toward building up the general health to the highest point—by a long course of tonics (including iron, strychnia, etc.), by change of environment, and by rest from care and worry and overwork and too frequent sexual intercourse. The rest indicated is very important, for the things mentioned

tend to keep the patient dragged down below par and in no condition to respond buoyantly and vigorously to any of the mental or physical requirements of daily life.

Endocrine disturbances are frequently the cause of diminished sexual response. Hypothyroidism is probably the most common in these depressed patients. Hypopituitarianism and hypoovarianism are also causal factors in some cases. Thyroid or pituitary or estrogenic hormone, alone or combined, should be given in adequate dosage according to the indications in the particular case. Androgen therapy also has been found decidedly helpful. Its libido-stimulating effects are emphasized in a 1943 article by Salmon and Geist, and a large series of patients so treated is reported by Greenblatt, Mortara and Torpin (Am. J. Obst. & Gynec. 44: 658, 1942).

SEXUAL HYPERESTHESIA

The increase of libido to a serious extent is rare, but occasionally there is a patient presenting this difficult problem. The first step in treatment is to remove causes of special congestion and irritation inside the pelvis (tumor, inflammation) or outside (vulvitis, pruritus, etc.). If that is not sufficient, then employ anti-estrogenic measures, along with ordinary sedatives as necessary. Greenblatt, et al., in the above reference, found that pure progesterone in large dosage tended to depress libido, and hence was useful in these cases.

PREMARITAL EXAMINATION

The premarital examinations required by law are primarily to exclude syphilis and gonorrhea. The exact requirements vary somewhat in different states. Detailed information and the forms to be filled out may be obtained from the state health departments.

In addition to the designated legal requirements, the patient wishes to know of course if there is anything that would interfere with marital life. In such conference, one practical point is to avoid disturbing the patient's happy mood by attaching undue importance to certain findings, such as uterine retrodisplacement without symptoms, small fibroid, cystic ovary or other local variation from the usual that may not cause trouble. "O K for marriage" is often sufficient to say to the patient on this point, though it is well to mention such special condition to the mother, along with the assurance that it is causing no trouble and probably best not to disturb the girl with the information unless trouble should develop. If the hymen opening is so small as likely to cause difficulty in coitus, it is advisable to enlarge the opening by stretching, with or without incision as necessary—local application of strong cocaine solution being used for stretching with graduated dilators, and novocaine injection for incisions.

The premarital conference is receiving much attention as a means of aiding the young couple toward a successful married life and toward the avoidance of those marital tragedies which often grow out of small misunderstandings and lack of knowledge. In addition to the helpful and reassuring information obtained at this conference, it encourages coming to the physician later for intelligent advice on minor disturbances (physical or relational) while they are still minor and before resentments grow and lead to permanent damage.

CHAPTER XVI

Disturbances of Function

MISCELLANEOUS DISTURBANCES

In this chapter we consider disturbance associated with the cessation of ovarian function (climacteric and menopause), allergic manifestations in the genital tract and breast disturbances closely connected with gynecologic work.

CLIMACTERIC DISTURBANCES

The term "climacteric" is used to designate the period of normal cessation of ovarian function, and "climacteric disturbances" are the general nervous and endocrine symptoms frequently occurring during that time. The term "menopause" is used to designate the definite cessation of menstruation which occurs normally at a certain stage of diminishing ovarian function.

There is increasing necessity for exactness in the terms employed in medical study and exposition. As our fund of knowledge increases and lines of investigation multiply, concepts grouped under one term require separation and clear definition one from the other. This is necessary in order to avoid ambiguity and confusion in the discussion of the separate parts of what was formerly referred to under one term or under various terms used synonymously. Many examples of this are found along the highway of medical advance, and this subject is one of them.

The age-period under discussion presents two phenomena, each important and each requiring study and decisions as to advice and treatment. One is cessation of the menstrual flow, a physical event easily identified. The other is more indefinite in time and content and runs through the long period of gradual cessation of ovarian endocrine influence, starting long before the menses cease and continuing long afterward. The terms "menopause," "climacteric," and "change of life" have been used interchangeably to refer to these two phenomena, meaning sometimes one and sometimes the other.

It has long been recognized by workers in this field that there should be a definite unambiguous term for each of these two concepts. Maranon, in his excellent work, states the problem clearly and furnishes a practical solution. He proposes that the long period of gradual cessation of ovarian function be designated as the "climacteric," and that the term "menopause" be used to designate the cessation of the menstrual flow. We agree thoroughly with this proposition. Intelligent technical discussion requires the adoption of exact terms, and the ones selected are practical and satisfactory. Hence they are adopted in this connection. If at times we drop into the old ambiguous use of the terms, it only demonstrates the force of habit.

It is interesting to note that developments in the cancer field bring additional necessity for exact limitation of the meaning of these terms. Investigations concerning cancer of the corpus uteri indicate that delayed menopause (late cessation of the flow) has a signification in regard to the development of endometrial carcinoma. The necessity in such investigations and discussions for a term to express exactly the cessation of the flow and nothing more, is apparent, and the term "menopause" is well suited for that purpose.

Before taking up the nervous and endocrine disturbances of the climacteric it is well to say a word concerning certain general aspects of this period

of natural ovarian involution or, more specifically, concerning the patient's general attitude toward it. This stage in the evolution of the individual is a step upward into new horizons. The duties of childbearing and the care of young children have been carried out, and the fruits of faithful work and developmental experiences arc ready for utilization in further progress.

The gradual shift of emphasis is a natural and helpful one. The reproductive structures, having fulfilled their appointed special functions, are now yielding the stage to the factors operative in the next step in the evolution of the human spirit. Every important change requires adjustments to new experiences, and these may be somewhat troublesome for a time until the nervous system has completed its adjustment. Understanding the beneficial character of this natural process, and that therapeutic measures are available to care for any disturbances that may occur, it is apparent that the gloomy forebodings of many women constitute borrowed trouble and unnecessary worry.

Even the hot flushes of the adjustment period are not always of troublesome extent. In his helpful articles on the management of this period, Novak calls attention to the exaggerated idea as to the frequency of marked disturbances. Questioning 100 patients who had passed through this period and who represented such varied social types that they could be considered a fairly cross-sectional group, he found that in 72 of the 100 there were no symptoms sufficiently troublesome to require medical help, in 20 there had been treatment by oral administration and in 8 the patient had been given hypodermic treatment with ovarian hormones for varying periods.

In only a small minority of individuals are these symptoms troublesome enough to require medication, and for those cases satisfactory medication is available. As far as menace to health and happiness is concerned, the endocrine disturbances of the climacteric do not compare with those of puberty and early womanhood, as can be readily appreciated by recalling the serious amenorrheas and menorrhagias of that period and the difficulties of their effective treatment.

Another point is that many of the disturbances which patients attribute to the climacteric are not due to this natural change but to organic or functional disorders having no connection with it. The general health must be looked after then, as at other times, if comfort and efficiency are to be maintained. This applies to all the organs, including the nervous system, which must always bear a major share of adjustment to changed conditions.

Recognition of the progressive and beneficial character of this "change of scene" in the drama of life, with the resulting cordial cooperation and studious curiosity and happy anticipation in the great adventure, constitutes the mainspring of a happy and successful "growing old." A vision of this basic fact, so often obscured by exaggerating the importance of minor things, would go far toward relieving the restless anxiety which afflicts so many at this important turn in the road. They focus attention on the fading scene as though that were their last view of life, forgetting that our evolutionary road leads on to still greater things.

While endocrine and other forms of medication may relieve minor disturbances of the climacteric, the relief of the troublesome "anxiety neurosis," which so many women bring on themselves, requires personal orientation to the basic facts of our progressive life. Then our natural curiosity becomes operative and we seek to learn something of the next developmental period through the facts and implications of the present one. This leads one to the outposts of knowledge, to the work of the pioneers and advance guards in the world-wide attack on the unknown in earth and sky and in the realm of the spirit. The vision widens and our daily ups and downs assume their proper place as developmental exercises in the spirit's school of experience, and the disturbing anxieties "fold their tents like Arabs and as silently steal away."

Endocrine Changes

The chief characteristic of the climacteric is the gradual cessation of ovulation and ovarian function. The ovary as it reaches the end of its functioning period becomes refractory to the action of the pituitary secretion, even though the pituitary continues to furnish the gonadotropic hormone. The excess of this latter hormone, chiefly pituitary A, is excreted in the urine, causing an increase of the urinary pituitary-like hormones over the former output. On the other hand, estrogens usually disappear from the urine. In some women in whom the ovaries have been removed, estrogen has been found in the urine. The explanation for this is not clear, but it is believed that some other endocrine gland, probably the adrenal cortex, plays a part in the production of estrogen after the climacteric.

The change in this pituitary-ovarian relationship is responsible for the symptoms occurring with the climacteric. There is undoubtedly a connection between the endocrine system and the higher nerve centers in the region of the pituitary, though this relationship is not well understood. Because of the interdependence of the various endocrine glands upon the proper functioning of each, it is easy to see that readjustment is necessary all along the line. The thyroid is the one most frequently disturbed in the climacteric, and the change may cause hypo- or hyperthyroidism. Hence it is important to check the basal metabolism rate before starting ovarian therapy.

Vasomotor Disturbance

The most constant climacteric symptoms are those due to the disturbance of the vasomotor system, such as hot flushes (involving the head, neck and upper part of the body or the entire body) and the sweats which frequently follow the flushes. These can be appreciated and described by the patient, and their frequency and extent serve as an index to the need and the success of therapy. It is little wonder that a patient who has been kept awake a good part of a night by repeated flushes, should be irritable, have a headache and even be a little neurotic.

Treatment.—In the first place, before any hormonal treatment is started, the physician should take time to explain to the patient that her condition is a normal one and that the symptoms can be relieved while she is making the required physical and mental adjustments to the shifting conditions. With some patients, a book on the subject would be helpful, and an excellent one to recommend is that by Novak, giving helpful information for the intelligent woman on the physiology and disorders of the reproductive system *(The Woman Asks the Doctor)*.

The comfortable adjustment to the changing conditions, which many make spontaneously, may be disturbed by two factors: namely, (a) some general or local disorder which lowers the adjusting capacity of the nervous system or (b) too rapid diminution in the natural manufacture of the ovarian hormones. Both of these factors must be looked after in treatment, for they react on each other, and troublesome symptoms are usually due to a combination of the two.

GENERAL HEALTH.—The general health is of first concern. In many of these cases the vasomotor symptoms would not have become troublesome if the adjusting capacity of the individual had been maintained, by attention to the general health and avoidance of exhausting or irritating household conditions. Also, full response to endocrine treatment cannot be expected as long as the various organs are depressed by anemia, vitamin deficiency, undernourishment, loss of sleep or persistent worry from any cause.

ENDOCRINE TREATMENT.—As previously mentioned, the thyroid is one of the endocrine glands most frequently affected in the climacteric, hence the basal metabolism rate is to be determined at the start of treatment. Depressed thyroid function is the usual type of disturbance. The hypothyroidism may be marked, with a low basal rate, or else moderate with a basal rate within normal limits. "Subclinical" hypothyroidism, that is, depressed function that does not yet show in the basal rate, is so frequently associated with climacteric symptoms that we give thyroid in all these patients who do not show elevated basal rate. Thyroid is started with a small dose and increased according to indications, as explained in detail under menstrual disturbances.

Ovarian Hormones.—The purpose of the hormone treatment is to augment the diminishing hormone supply up to the patient's capacity for comfortable adjustment. After attention to the general health and any thyroid disturbance as mentioned, we come to the details of substitutional treatment with ovarian hormone or hormones.

If the vasomotor disturbances are very troublesome, it is well to start the patient on intramuscular injections until the symptoms are brought under control, and then to use a combination of oral preparations and intramuscular injections as needed. Other forms of administration which can be used are vaginal suppositories, inunctions, and subcutaneous implantation of specially-prepared hormone pellets.

Concerning dosage, the smallest dose giving relief for twelve to twenty-four hours should be used, and this rarely exceeds 10,000 U. The dose vaginally should be about equal to the intramuscular dose, while orally the dose needs to be about five times as strong. The dose can gradually be decreased as the symptoms improve.

The estrogen which has the most prolonged effect is estradiol dipropionate. In a clinical comparison with estrone, Dorr and Greene conclude that estradiol is of unusual clinical value in that injections may be given at very infrequent intervals. The use of subcutaneous theelin pellets is reported by Bennett, Biskind and Mark.

Werner, in a recent survey of estrogenic dosage, concludes that estrone (theelin) is more potent in the human than alpha-estradiol benzoate (progynon-B), stating:

"The assay of estradiol and its compounds on the rat greatly magnifies their activity, because of the extreme sensitivity of the rat to these substances. This same degree of sensitivity to estradiol and its compounds is not present in the human being, nor even in the mouse. . . .

"Published research indicates that extremely large dosages of alpha-estradiol benzoate (progynon-B) are necessary to duplicate the effects of comparatively small dosages of theelin (estrone) in the human being."

Stilbestrol is a synthetic estrogenic substance which has the advantage of low cost. It has been tried out in several clinics with varying results. Huberman and Colmer noted improvement in 90 per cent of 77 climacteric women under stilbestrol. The incidence of toxic effects varied from 10 per cent to 80 per cent in different reports. These consisted of nausea, vomiting, and vertigo.

They may be eliminated for most patients by employing doses of 0.5 mg. (or even starting with 0.1 mg. in hypersensitive individuals), by giving the dose at bedtime, and by interrupting the administration at regular intervals (see cyclical therapy, page 256).

Schneider recommends the prophylactic use of the estrogens after removal of the ovaries and after radiation to stop the menses, and he feels that the patient has a much easier time adjusting herself to the climacteric.

During the course of treatment with these estrogenic substances, bleeding due to withdrawal may occur. This is especially true when the dose used has been excessive. Most workers in the field regard this with a nonchalance which is refreshing if not reassuring. In the first place, bleeding at this age when fundal cancer is most common is disconcerting. One cannot be certain without curettage that an early carcinoma is not the cause of the bleeding, along with the estrin withdrawal. In the second place, stimulating the growth of the endometrium, which is supposed to be atrophic at this age, is not an altogether safe procedure, according to the knowledge gained from animal experimentation and clinical work.

Because of our feeling in this matter we have for years used the corpus luteum hormone in menopausal women except in patients where the uterus had been removed, and our results have been comparable to those obtained by estrogen. The only drawback to this form of treatment at present is its cost. Other forms of treatment which have been suggested are testosterone propionate and x-ray of the pituitary gland.

The vaginal smear method of the following treatment, recommended by Papanicolaou and Shorr, enables objective confirmation of the subjective indications of the effectiveness of the treatment. It is particularly helpful in the handling of cases in which the patient's reports are variable and of uncertain dependability. In their instructive article on the subject they give a helpful tabular description of the progressive changes in the vaginal climacteric smear under treatment (Fig. 1084) and also photomicrographs of the smears in various stages of treatment (Figs. 1086 to 1097). In the following quotation, they point out the difficulties of classification, the modifications occasioned by the variations in the original climacteric smear, and the types of original smears. It may clarify the titles to point out that the term "menopause" in the quotations refers to the menopause period or climacteric—hence the patient may still be menstruating at times and thus may have a "premenstrual type" of smear. It is only after ovarian involution has progressed to complete cessation of menstruation that the atrophic smear is found at all times.

The variations in the urinary excretion of the pituitary-like hormones in climacteric patients under treatment are graphically shown in Fig. 1085, from the article on the menopause period by Frank, Goldberger and Salmon.

A classification of the progressive stages in the transition of the menopausal smear to the follicular type would greatly assist in the uniform evaluation of the effects of treatment. A detailed description of the morphologic changes would be too extensive for the scope of this paper and too cumbersome for practical use. Furthermore the variability in the initial smear picture and the overlapping in some of the alterations under treatment would render a rigid schema inaccurate and misleading. A simple system can, however, be suggested into which the most fundamental changes in the significant elements of the smear may be fitted.

This has been done in the Table (Fig. 1084). The alterations in the constituents of the smear have been arranged, as far as possible, in the order in which they usually appear, and in relation to each other. It should be remembered that there is much overlapping, and considerable variability in the tempo of the various changes. Leucocytes and deep cells, for example, may disappear unusually early, or persist in small numbers at relatively advanced stages. The descriptive terms—early, moderate, advanced, and complete—are considered preferable to the designation of stages by numbers.

One of the chief obstacles to a rigid classification appears to be the variability in the original menopausal smears. As has been pointed out, this arises from the differences in the degree of atrophy of the genital organs and the cyclical changes which persist after menopause. Although the character of the original smear bears no relation to the intensity of symptoms in patients with the menopausal syndrome, it will modify, to some extent, the changes taking place under treatment. For this reason it may be of value to describe the several types which have appeared with sufficient frequency and uniformity as to be readily recognized.

a. *The Menopausal Atrophic Type.*—This is most frequently seen in the surgical menopause. It is apparently dependent on absent or minimal ovarian activity, and is associated with an advanced atrophy of the genital tract. It is characterized by an abundance of well-preserved leucocytes and deep cells, and varying numbers of erythrocytes. Mucus is moderate in amount and bacteria profuse.

b. *The Intermediate Type.*—This is marked by a prevalence of superficial cells in relation to the deep cells, which are also present in fairly large numbers. The superficial cells are irregularly formed, folded, and densely grouped. They have relatively large nuclei. The leucocytes are usually numerous, but poorly preserved. Erythrocytes may be present or absent. Mucus is moderate and bacteria are abundant.

c. *The Mucous Type.*—This is featured by an excess of mucus, usually associated with some bleeding and typical fibrination. Deep cells may prevail or be less numerous than the superficial cells. Leucocytes are abundant, but diluted by the profuse mucus, as are the bacteria which are also present in large numbers.

d. *The Premenstrual Type.*—This has a strong resemblance to the normal premenstrual smear. The cells are irregularly folded, appear in dense clumps and have relatively large nuclei. The leucocytes are usually numerous but poorly preserved. Erythrocytes may be present or absent. Mucus is, as a rule, moderate in amount, but may be scant or relatively abundant. The bacterial flora is rich. Deep cells are usually absent, and, when present, are rare.

e. *The Bacillus Vaginalis Type.*—This is characterized by a rich growth of a bacillus closely resembling the Döderlein bacillus. Superficial cells with relatively large nuclei prevail. Deep cells may be present in moderate numbers or absent. One of the chief features of this smear type is the fragmentation of the cells and the liberation of large numbers of nuclei. Leucocytes are present in fair numbers, but mostly degenerated and fragmented. Erythrocytes may or may not be present. Mucus is usually moderate.

f. *The Pseudo-Leucopenic Type.*—This is marked by a pronounced leucopenia. Leucocytes may be found, but are usually degenerated or fragmented. Most of the cells are of the superficial type, irregular, and heavily grouped. The nuclei, as a rule, are relatively large, though small nuclei may prevail in some cases.

Vaginal smear and endometrial biopsy studies have led to epochal gains in the accuracy and extent of our knowledge of the normal and abnormal functioning of the reproductive system. These methods are indispensable in the most effective experimental work, where accurate objective evidence is imperative, and the understanding of their forms and implications is fundamental to an understanding of the physiology of these organs.

Smear Elements	Menopausal Smear Before Treatment		Effect of Treatment on Smear			
	Typical Atrophic	Variations	Early	Moderate	Advanced	Complete
Mucus	Moderate or scant. Rarely abundant.	Same.	Abundant.	Moderate or scant.	Moderate or scant.	Moderate or scant
Leucocytes	Numerous.	Numerous or moderate. Rarely leucopenia.	Diminishing.	Progressive diminution.	Relative leucopenia	Leucopenia.
Erythrocytes	Usually present in moderate numbers. Rarely numerous. Often fibrination.	Less frequent; in small or moderate numbers.	Unchanged or increased in number. Fibrination.	Diminished or absent.	Absent	Absent.
Clearness of smear	Hazy or "dirty." Rich in bacteria.	Same.	Usually unchanged.	Progressive clearing	Clearer	Clear
Deep cells	Numerous.	Less numerous. May be rare or absent	Unchanged or decreased in number.	Diminished or absent.	Absent or very rare.	Absent.
Superficial cells	In varying numbers.	Numerous; prevailing.	Usually unchanged. Cells less numerous in general.	Sharper outlines. Elongate or navicular forms often numerous.	Sharper outlines. Flatter. Cells with small nuclei increase in number.	Sharp outlines Larger. Flatter Cells with small pyknotic nuclei prevailing.
	Irregular or folded. Poorly outlined; most with large nuclei.	Same type Cells with small nuclei less frequent; rarely prevailing.				
Grouping of cells	Moderate.	More pronounced. Often dense smudgy clumps.	Very little or no change.	Progressive spreading. Sometimes dense groups persist	More spreading; more isolated cells.	Smaller, looser groups; many isolated cells.
Typical cornified cells	Absent.	Absent.	Absent.	Usually absent May begin to appear.	In varying numbers	Many

Fig. 1084.—Classification of smear types and transitional stages of the menopausal period during treatment with ovarian follicular hormone. (Papanicolaou and Shorr—*Am. J. Obst. & Gynec.* As reproduced by Squibb)
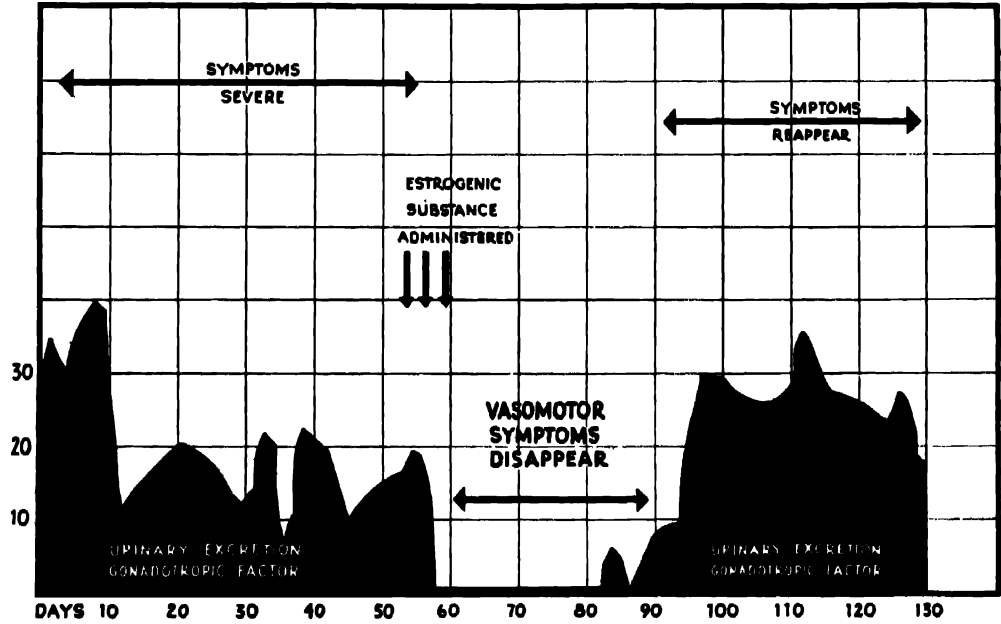
Fig. 1085.—Variations in amount of the gonadotropic factor in the urine during treatment in the menopause period (climacteric). (Frank, Goldberger and Salmon—*New York State J. Med.* As reproduced by Squibb.)
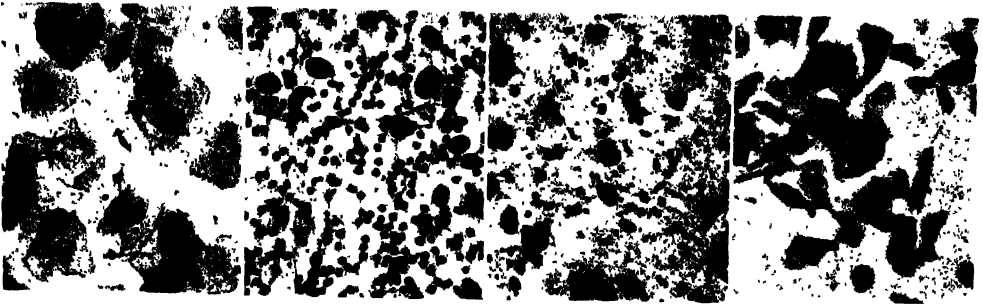
Fig. 1086.   Fig. 1087.   Fig. 1088.   Fig. 1089.

Fig. 1086.—Follicular phase of a normal woman at the eleventh day of the menstrual cycle. Note absence of leucocytes and prevalence of large flat cells with pyknotic nuclei.

Fig. 1087.—Age thirty-eight; surgical menopause before treatment. Note abundance of leucocytes and prevalence of round or oval deep cells with large nuclei. Some erythrocytes are present. Such slides have a "dirty" appearance and are notably free from the deep stain indicative of mucus.

Fig. 1088.—Ten hours after second injection of amniotin (total 8,000 I.U.). Note abundance of mucus secretion as an early effect of treatment. Leucocytes are much less numerous.

Fig. 1089.—Twenty-four hours later, third injection (4,000 I.U.) was given (Feb. 21), smear taken Feb. 22. Leucocytes and erythrocytes have disappeared. As treatment progresses very numerous large flat cells with pyknotic nuclei take the place of the smaller and less numerous cells with large nuclei previously prevailing.
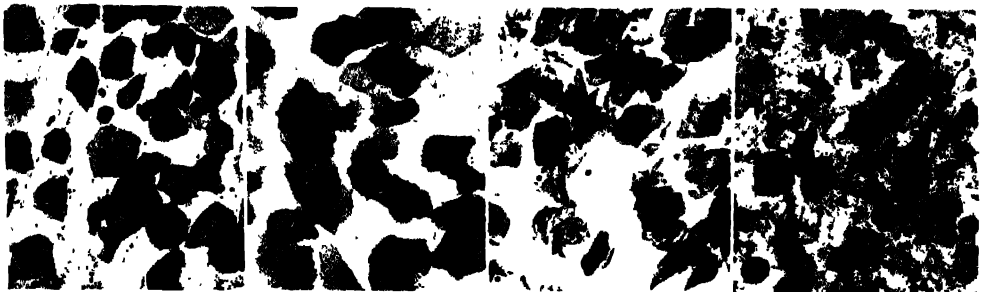
Fig. 1090.   Fig. 1091.   Fig. 1092.   Fig. 1093.

Fig. 1090.—Smear taken Feb. 27 (total dosage now 34,000 I.U.). Early follicular phase. Note absence of leucocytes and mucus as well as "clean" appearance of slide. Large flat cells with pyknotic nuclei are more numerous and more developed. At this stage there is marked symptomatic improvement in the severity and number of flashes.

Fig. 1091.—March 4 (total dose, 58,000 I.U.), smear shows typical follicular phase, not unlike Fig. 1086. This is the optimum stage in the management of the patient.

Fig. 1092.—March 16, regressive grouped type of smear induced by insufficient oral treatment.

Fig. 1093.—March 16 to April 1, treatment discontinued. Smear taken March 31 shows further regression. Leucocytes and deep cells have reappeared. Symptoms gradually returned.
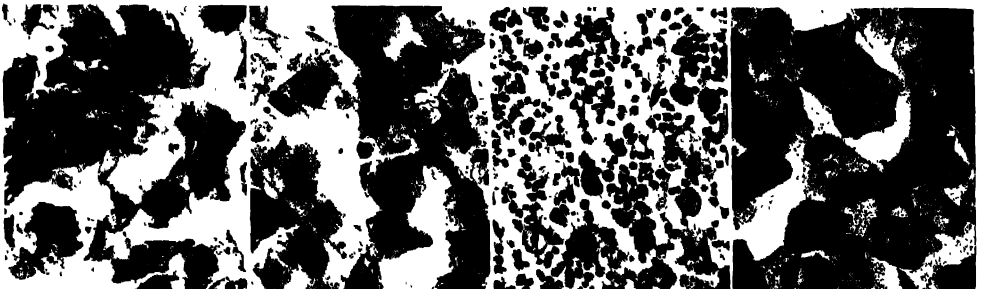
Fig. 1094.   Fig. 1095.   Fig. 1096.   Fig. 1097.

Fig. 1094.—Grouped type without leucocytes, after resumption of treatment.

Fig. 1095.—May 1, after 64,000 I.U. in thirty days, smear returns to typical follicular type and the patient's distressing symptoms again disappeared.

Fig. 1096.—Almost complete regression to original menopausal type of smear after discontinuation of treatment.

Fig. 1097.—Follicular phase following resumption of treatment.

Figs. 1086 to 1097.—Showing changes in the vaginal smear of a typical climacteric patient during administration of estrogenic substance. (Papanicolaou and Shorr—Am. J. Obst. & Gynec. As reproduced by Squibb.)

In the handling of climacteric patients, however, the subjective symptoms may be taken as a fairly reliable indicator of the effectiveness of the medication being employed. In exceptional cases, examination of vaginal smears may be needed as a check-test, as in a case where there seems to be marked exaggeration of symptoms or where symptoms persist in spite of medication that is ordinarily sufficient, but in general the symptoms may be taken as a guide in instituting and varying treatment.

On this point, Werner concludes as follows, in his article surveying estrogenic dosage: "The most easily obtainable and dependable criterion of sufficient estrogenic dosage in the climacteric and related conditions is relief of subjective symptoms as expressed by the patient." He quotes the following from Broun:

"It is quite evident from the present study that changes in the vaginal secretion are a much less delicate index of the effectiveness of estrogenic material than is examination of the uterine mucosa secured by curettage. In the smallest dosages employed the changes in the uterine mucosa were definite and striking. It is also quite obvious that symptomatic relief can be secured in dosages that are too small to produce definite changes in the vaginal secretion, since the group of subjects receiving the smallest dosage apparently secured as much relief of symptoms as those who received larger doses."

Werner also quotes Edgar Allen: "We have found the relief of symptoms a more accurate guide to proper dosage than the changes in the vaginal smear."

Other Disturbances

Associated With the Climacteric

Atrophic Vaginitis.—This is often troublesome and refractory to treatment in the latter part of the climacteric and in the postclimacteric (senile) periods. The administration of estrogen in the form of vaginal suppositories helps greatly in clearing up these cases.

It was hoped that that other troublesome atrophic disturbance, leucoplakic vulvitis, might be similarly benefited by estrogenic medication, but so far results have been disappointing.

Pruritus Vulvae.—Pruritus vulvae, vaginal burning, and other paresthesias of the climacteric and senile periods are sometimes definitely benefited by estrogenic medication. In these cases it is well to employ the vaginal suppository method of administration, to be supplemented, if necessary, by oral or hypodermic methods.

There are other disturbances which in some cases seem to be influenced by the more remote effects of endocrine medication.

Emotional Disturbances.—Troublesome emotional and mental states are sometimes much benefited by endocrines of the ovarian-pituitary cycle. This subject is being investigated in its various ramifications, but enough information has already been accumulated to show that endocrine investigation and treatment can help many of these patients not relieved by other measures.

Arthritis.—Certain cases of arthritis in the climacteric are benefited by ovarian endocrine medication. This so-called climacteric arthritis seems to locate principally in the knee. In one of our patients the effect was so marked as to be surprising.

The patient was referred by the orthopedist for trial of endocrine treatment before deciding on operation, which was being considered because of the marked swelling, disability, and x-ray evidence of internal disturbance in the knee joint. The patient had had a rather sudden menopause caused by x-ray. Within two months after starting the course of corpus luteum therapy, there was definite improvement in the knee. This continued, and later the patient was able to dispense with her cane, could walk upstairs, and eventually returned to work. Part of the swelling remained in the knee, but the tenderness and disability were gone. In this case the element needed to restore endocrine balance seemed to be the corpus luteum hormone. After considerable improvement had been secured by a course of this hormone by oral administration, an estrin preparation was substituted for the corpus luteum, to see if improvement could be hastened thereby. The estrin had the opposite effect. The joint became worse, pain and disability returned, and the patient requested that she be allowed to go back to the former medication. Return to the corpus luteum medication started improvement again, and it continued.

Reports in literature indicate that in a variety of joint conditions in the climacteric, medication with endocrines of the ovarian-pituitary cycle may be beneficially employed as part of the treatment. This, however, should not be taken as an occasion or excuse for haphazard endocrine medication, nor for neglect of the thorough general investigation for which every attack of arthritis or rheumatism calls in order that any hidden focus of inflammation may be ferreted out before it results in serious cardiac complications.

In obscure cases of arthritis in this critical involutional period which do not yield to the regular treatment, it would be well to add a trial of this type of endocrine medication to the systematic handling of the condition.

Allbright, Smith and Richardson feel that the late climacteric state is a common etiologic factor in osteoporosis. This type usually involves the spine and pelvis. The long bones are seldom involved and the skull almost never. In the early stages of the disease, urinary calculi are common, due to increased calcium excretion. In the later stages the disease is likely to be discovered by x-ray examination made because of sudden backache from an apparently inconsequential trauma, such as a minor jolt received when the auto goes over a small bump. They hold that the beneficial effect of estrogen treatment is due to its ability to aid in calcium retention.

Hypertension.—In regard to hypertension in patients in the climacteric, about the same may be said as for arthritis. It may be added, however, that in a large proportion of these cases this type of endocrine imbalance seems to be a factor of some importance, and hence it is well to add ovarian endocrines as part of the treatment to take care of this factor.

Miscellaneous.—There are various other conditions such as involutional melancholia in which a disturbed endocrine balance of the climacteric may be a factor requiring treatment, and recognition of this fact may aid materially in restoring the patient's health.

MENOPAUSE DISTURBANCES

The menopause bears the same relationship to the fifth decade of life that the menarche does to the second decade, that is, it is the outward sign of important physiological changes in the ovaries and the uterus. At puberty, these internal changes are developmental toward establishment of function, and

when ovarian function has developed to a certain extent, menstruation appears (menarche). At the climacteric, the changes are regressive toward cessation of function, and when it has regressed to a certain extent menstruation disappears (menopause).

The menopause then is the climacteric cessation of menstruation. It is not the gradual approach to it represented by occasional amenorrhea of climacteric origin, but the complete and permanent disappearance of the menstrual flow.

Problems of the Menopause.—The problems of the menopause were considered by the authors in an article in the *American Journal of Surgery* ("Amenorrhoea, Menorrhagia, Metrorrhagia, and Delayed Menopause") and that work-up of the subject has been drawn upon freely for this presentation.

The problems connected with the climacteric cessation of menstruation may be indicated by the following questions. Are the conditions and phenomena normal or pathological? If pathological, in what way and why, and what should be done about it? The first question brings up the inquiry as to what constitutes a normal menopause.

At what age does menstruation normally cease? What is the earliest age at which it may cease and still be considered normal? What is the latest age of normal cessation? These queries open a field not yet sufficiently investigated. We know that the age at which the normal menopause takes place varies greatly in different individuals, but we do not know the exact limits of this normal variation. However, for the present consideration of abnormalities, the current approximate estimates of what is normal may be used.

In regard to the age at which the menopause occurs, this permanent cessation of menstruation may take place any time within the limits of the fifth decade (age forty to fifty years). However, suspicion of abnormality should be aroused by menopause occurring before the age of forty-two years or delayed to the age of forty-eight years, and the greater the variation below or above these limits the greater the probability of some pathological process.

The definite disturbances of the menopause are two, premature menopause and delayed menopause. In this connection it may be well to refer also to certain premenopausal disturbances, namely, amenorrhea, hypomenorrhea, menorrhagia and metrorrhagia. These various menopausal and premenopausal disorders will be taken up under three headings, premature menopause, premenopausal disturbances and delayed menopause.

Premature Menopause.—Premature permanent cessation of menstruation may be due to some local lesion or some general condition or some endocrine disorder. As in the case of serious amenorrhea of an earlier age, the local lesions causing premature menopause are those affecting the integrity of the endometrium or of the ovarian functioning tissue.

In the former class come hysterectomy and hyperinvolution of the uterus. In the latter class come double oophorectomy and tumors or other disease causing destruction of the ovaries. An incurable blood dyscrasia or some disease of the respiratory, gastrointestinal, urinary or cardiovascular systems may so weaken the patient as to cause permanent cessation of menstruation, and the same may be said of certain incurable disorders of the endocrine glands.

In conditions which do not necessarily preclude further menstruation, an attempt at restoration may be made along the lines of treatment already advised for severe amenorrhea.

Premenopausal Disturbances.—In premenopausal menorrhagia and metrorrhagia, the same treatment is to be employed for the different types of cases as advised for similar disturbances at an earlier age. A larger proportion of the bleeding cases of this late age-period have carcinoma of the endometrium and hence diagnostic and therapeutic curettage becomes urgent earlier in the disturbance.

In premenopausal amenorrhea and hypomenorrhea, the same etiological factors are to be looked for as in similar disturbances at an earlier age, and similar treatment is to be employed for the various types of cases.

Delayed Menopause.—Delayed menopause and late menopause are terms used synonymously to designate that condition in which the permanent cessation of menstruation is delayed beyond the normal time. In the clinical consideration of this group we include all cases of late uterine bleeding, whether or not presenting the rhythmic character of menstruation. In giving the history, patients usually regard any recurring bleeding as menstrual flow and an appearance of blood after cessation as a return of menstruation.

Accepting this composite group for investigation, pelvic examination will show the cases in which the late bleeding is due to a demonstrable local lesion, such as carcinoma of the cervix or corpus, uterine myoma, ovarian tumor, or a tumor or inflammation of some adjacent structure. Further investigation will identify the cases presenting some extrapelvic disease which may be the cause of the bleeding, such as blood dyscrasia or cardiovascular-renal hypertension or thyroid disorder.

There remains a small group of cases presenting no evident genital lesion nor extragenital disease to account for the bleeding, and in which the bleeding simulates more or less the menstrual rhythm. This is a most interesting group, presenting unsolved problems in pelvic physiology and pathology. The patients are past the usual age for normal ovarian functioning and yet they present evidence of endometrial activity dependent on ovarian activity.

Are these cases simply examples of unusual disparity between the age in years and the age in physical changes, and consequently due to run a normal course to a later menopause? Are they, on the other hand, cases representing an irregularity of functional decline which may impose a pathological influence on the cell activity of the involuting endometrium? We have given considerable thought to this interesting problem and its practical bearings, and some features were presented in a previous article. The ramifications of the subject are extensive and space consuming, but the practical conclusions from our study may be stated as follows:

1. Delayed menopause, especially when delayed to the age of fifty years, means some pathological condition, either in structural change or in cell activity. The influence of persisting irregular ovarian activity on the cells of the involving endometrium tend to erratic cell activity thereby favoring cancer development. In our series of 89 cases of cancer of the corpus uteri, there were 30 in which there was a definite interval between the menopause and the clinical appearance of the endometrial carcinoma. In these 30 cases the menopause occurred at the age of fifty years or later in 22 or 70 per cent, and at age of forty-eight years in 3 other cases.

2. Endometrial hyperplasia in the endometrium of involutionary age seems to represent a step in the pathological progress from normal endometrium to carcinoma. Hyperplasia is a very frequent finding at curettage for bleeding in this age-period when carci-

noma is most common. In our series of cases of endometrial carcinoma a few of the patients had been curetted, in their home town or elsewhere, one or two years previously. In 3 such cases the slides of the previous curettings were available for study and each of them showed definite hyperplasia at that time. Here, in this one series of cases, there were 3 instances in which curetting showed benign hyperplasia and another curetting one to two years later showed endometrial carcinoma. There was also an interesting specimen of a double uterus in which one horn showed endometrial hyperplasia and the other horn endometrial carcinoma.

3. Delayed menopause, especially when delayed to the age of fifty years, is an indication of aberrant endometrial activity and a warning of a tendency to endometrial malignancy. Consequently, appropriate treatment should be employed to stop the aberrant endometrial activity.

4. Appropriate treatment consists usually of curettage (to stop the bleeding temporarily and to furnish tissue for microscopic study), conization of the cervix if needed for chronic cervicitis, and radium treatment to stop the erratic endometrial and ovarian activity. If there is no malignancy in the curettings or in the cervical tissue, the treatment outlined is usually sufficient to prevent further trouble. If the microscopic investigation of the curettings shows that endometrial carcinoma has already developed, then radical measures for that must be employed.

ALLERGIC DISTURBANCES

The fact that allergic patients may have pelvic symptoms directly referable to the allergic constitution, has been shown by Duke, Rowe, D. R. Smith, and others. According to Rowe, allergy may be a factor in painful periods with or without vomiting, in excessive or scanty periods, in prolonged periods, in leucorrhea, and in eczema of the vulva. In a series of patients with allergic dysmenorrhea, Smith was able to give relief by proper dietary investigation and advice. As remarked in the chapter on Menstrual Disturbances, it is rather strange that this connection between allergy and dysmenorrhea (painful uterine contractions) was not appreciated long ago, since the test material of antigens is the uterus of an experimental animal.

Relief in scanty, excessive, and prolonged menstruation has been reported by Rowe, who recommends his elimination diets in testing suspected allergic cases. The mechanism by which the control of the flow results in such cases is not clear, but it is supposed to be due to improved ovulation.

In allergic persons, this factor may enter into the cause of leucorrhea. Mucous discharge from the gastrointestinal tract and from the bronchial and nasal membranes has long been recognized as due in certain cases to allergy. In women and girls with excessive vaginal discharge, in whom there is no infection and in whom the vaginal smear shows a predominance of epithelial cells, the question of allergy should be investigated.

Eczema of the vulva is a condition recognized as sometimes due to allergy, and any case persisting despite ordinary treatment merits attention in that direction.

There have been cases reported of menstrual asthma in which the patient was found to be sensitive to some allergen present in her own blood at the menstrual time. A sample of blood taken at the menstrual time was preserved —injected in the interval period, and it caused an asthmatic attack. The patient was cured by gradual desensitization to her own menstrual allergen.

In the chapter on treatment (Chapter III) attention was called to the necessity of allergic investigation and treatment in connection with some gyncecologic disorders, and to some of the fundamentals of the subject and a table was given showing the proportionate prevalence of allergic reaction to the more common contact substances. The facts there cited and the additional items mentioned here show that allergic investigation should be considered in any erratic disturbance of uncertain origin, particularly in sudden edemas without obvious cause.

Fig. 1098.—A uterus removed from a markedly allergic patient and showing great swelling and edema of the mucosa and muscularis with nothing to account for the condition except allergy. The details of this and other cases, given in the articles, furnish food for thought from the pathologic, diagnostic, and therapeutic standpoints. (Goodall and Power—*Am. J. Obst. & Gynec.*)

Goodall and Power in a thought-provoking article on this subject, present Fig. 1098 as an example of allergic edema of the uterine mucosa and muscularis.

"Fulminating pelvic edema" is the term applied to an intense and widespread edema of the pelvic interior, that comes on suddenly without apparent adequate cause. It is accompanied by serious symptoms and usually extreme prostration. In fact, the sudden onset, the severity of the symptoms and the marked collapse suggest ruptured tubal pregnancy, and this mistaken diagnosis has been made in some of the cases. It is a rare condition and presents a puzzling problem in etiology and in diagnosis. Most of the cases have been

associated with chronic inflammatory lesions in the pelvis, but why the sudden edema and serious symptoms should develop without apparent case has not been satisfactorily explained.

Possibly allergy is a factor in this intense edema localizing in the pelvis. The cause of the localization in the pelvis may be sensitization of the tissues to the products of old inflammation or of some other local condition. The salient features of the symptomatology and pathology of this bizarre disorder can best be presented by detailing a personal experience with it. Several other cases were found reported in literature.

Fulminating Pelvic Edema.—The senior author was called in consultation to see a patient with pelvic disturbance. It was Sunday; the patient had attended church in the morning feeling fairly well, but while there became very sick and could scarcely get home. She had a chill, followed by severe headache and general aching, but no localizing symptoms. There was no apparent local trouble in any part of the body to account for the fever, which rose to 105.5°. By evening there was evidence that the pelvis was the seat of the disturbance and it was then the author was asked to see the patient, about 10 P.M.

Examination.—The temperature had been reduced to 104°. The pulse was rapid, but of fair volume. The pelvis was filled with a tender mass which surrounded the uterus and fixed it firmly. There seemed to be acute pelvic inflammation with extensive exudate, but there was no apparent cause, either recent or remote. The patient had always been rather nervous and this nervousness had been somewhat worse of late, but there had been no symptoms indicating pelvic disease of any kind. The next day the temperature was 104.2°, pulse 120, respiration 28, and there was much peritoneal irritation. Operation was indicated to check the rapidly progressing inflammation if possible, and accordingly the patient was taken to the hospital.

Operation.—When the abdomen was opened the pelvis was found filled with small encysted collections of fluid involving the tubes, ovaries, broad ligament, and uterus. The cysts or pseudocysts were of various sizes, were filled with clear serum and seemed to extend deeply into the substance of the organs involved. From the appearance, hydatid disease was suspected. All the cysts that it was feasible to remove were removed, and the pelvis drained through the abdominal incision.

The temperature dropped within a few hours to 98°, and it did not again go high. During the first part of the period of convalescence it ranged from 99° to 100.2°, and later dropped to normal, where it remained. The wound and drainage tract healed rapidly and the patient had a smooth convalescence. Laboratory examination of the tissues removed showed no bacteria of any kind, no evidence of hydatid disease, and no specific pathologic process that would adequately account for the alarming symptoms and the marked tissue change.

BREAST CONSIDERATIONS

The functioning of the breasts runs parallel with that of the ovaries and the uterus, as indicated in Fig. 1099. The connection of the breasts with the nourishment of the newborn brings them to that extent into intimate relation with obstetric practice. The radical treatment of cancer of the breasts brings them within the province of general surgery in its application of extensive dissection to the chest wall and adjacent lymphatic areas. Along with the treatment of breast cancer goes of course the diagnosis of that disease, and also the recognition and diagnostic observation and treatment of the various other conditions that may simulate cancer or require surgical care.

There are, however, certain points of contact with gynecologic practice, including breasts painful at menstrual time, hypertrophy of the breasts, and discharge from the nipples.

LACTATING

ADULT

PUBERTY

PRE-PUBERTY

INFANTILE

F. Netter M.D.
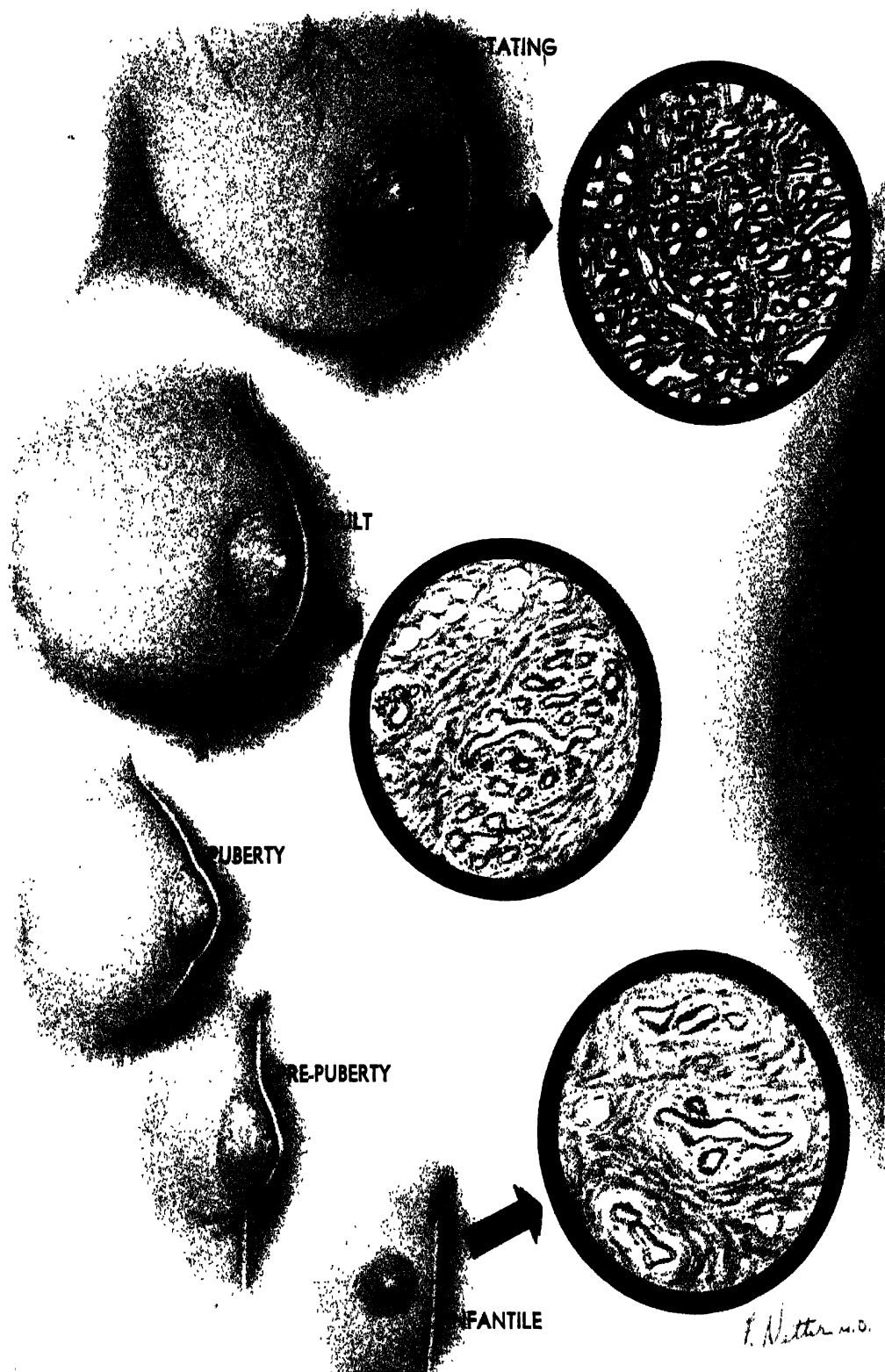
Fig. 1099.—The Breast at Different Ages. (Netter—Ciba Pharmaceutical Products, Inc.)

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Painful Breasts; Hypertrophied Breasts; Abnormal Discharge

Taylor made an extensive study of chronic mastitis in relation to ovarian and pituitary hormones and to gynecologic lesions. The paper was based on the clinical and laboratory study of 261 patients with nonmalignant breast disturbance handled in the Memorial Hospital in the preceding two and a half years. It was divided into two parts—(a) a general and histological study and (b) a clinical study of the patients. His conclusions and comments were as follows:

The general conclusion of this study is that a certain minimum activity of the ovary is necessary for the development of chronic mastitis but that no specific hyperfunction or hypofunction of the ovary is at present demonstrable. This result is contrary to hopes entertained at the beginning of the work and contrary to what might have been expected from the known proliferative effects of the ovarian hormone on the breast tissue.

Certain exceptions and reservations must be made. In one small group of cases in which swelling of the breast, sometimes with secretion, develops in the presence of a persistent follicle or corpus luteum cyst, a hormone cause is probable, but the clinical aspects of this condition are different from that of the common type of chronic mastitis with painful outer quadrant induration. It is not unlikely that other unrecognized reactions of the breast to certain hormone states may exist.

Even for the common type of mastitis, however, it must be conceded that the present method of study has not exhausted the possibilities of a hormone cause. Present technical methods for the clinical determinations of estrin and prolan are far from perfect and no satisfactory test exists for the quantitative study of the corpus luteum hormone in body fluids. A very slight disturbance of gland function might cause hyperplasia in the breast when active over a considerable number of years and yet not be obvious when studied by relatively crude laboratory methods over a month's time. Irregularities in the peaks of production or excretion of estrin may furthermore have a significance quite aside from the total quantities chiefly discussed in this paper.

Finally, it is possible that the abnormal estrin effects on the breasts may be the result of local conditions such as an increased responsiveness to normal quantities of hormone, possibly as the result of local hyperemia, or a tissue concentration of the gland substances, bearing no relation either to the actual activity of the ovary or to the amount of hormone in the blood stream.

With these reservations, the following summary is offered of the present knowledge of the conditions under which chronic mastitis is found to develop.

A. THE PAINFUL NODULAR BREAST

1. *An active ovary producing estrin must be present.*—(a) The painful breast is limited to women before the menopause and after puberty. (b) The pain and nodularity improve with x-ray and surgical castration, such improvement paralleling the fall in estrin excretion in the urine.

2. *There is no indication of an extensive ovarian activity.*—(a) The histological structure of the painful breast does not show the uniform epithelial proliferation of a hormone-produced hyperplasia. (b) The 7 cases studied did not contain any excess of estrin in the urine or blood and in several cases the estrin excretion was quite low. (c) The endometrium in cases of the painful breast does not show the hyperplasia to be expected with hyperactivity of the ovarian follicle. (d) Administration of considerable quantities of ovarian hormone to patients with the painful breast does not increase the severity of the symptoms.

3. *There is no indication of an underfunction of the ovary.*—(a) The average excretion of estrin in 7 cases which were studied was within normal limits and in several of these cases rather high values were found. (b) The scant menstruation noted in 16.9 per cent of the women with the painful breast was the chief evidence for the underfunction theory,

but the estimation of the estrin excretion in such cases gave normal values. (c) Consistent results have not been obtained in this clinic by the treatment of the painful breast with estrin or the ovary-stimulating hormone of the anterior pituitary.

4. *A "dysfunction" of the ovary remains a possibility which cannot be entirely excluded.*—(a) Delayed or irregular menstruation, which must be accepted as a sign of a disturbed ovarian function, was present in 13.7 per cent of the cases. (b) Irregularities in the curves of estrin excretion or of blood concentration may eventually be shown to have some significance, but knowledge for their interpretation is at present lacking. (c) The multicystic ovaries observed in so many cases also may be taken as evidence of a disturbed ovarian function but they may be looked upon as well as the result of vascular congestion in the pelvis.

5. *A corpus luteum disorder cannot be excluded since tests do not exist for studying the blood and urinary levels of this hormone.*—(a) The frequency of normal menstrual rhythm, the histological evidence of a regular endometrial cycle, and the rarity of evident disease of the corpus luteum in patients operated upon are evidence against this factor.

6. *There is no indication of a hyperactivity of the anterior pituitary.*—(a) Prolan appears in the urine only in cases of pronounced underfunction of the ovary, which is never found with the painful breast. (b) An increase in prolan in the urine comparable with that taking place in the menopause has been excluded by the present series of studies. (c) The appearance of prolan in the urine after x-ray of the ovaries occurs at the time of improvement of breast symptoms.

7. *The painful breast has from the clinical viewpoint a large nervous element.*—(a) The pain and tenderness are more marked than are to be expected in an endocrine-produced glandular hypertrophy. (b) The pain radiates to the arm, neck, axilla and lateral body wall and may be associated with hyperesthesia of the skin of the whole thorax. (c) The pain and swelling in certain cases are produced or become worse during periods of nervous tension and may even develop abruptly within a few minutes after a nervous shock at any time in the monthly cycle. (d) Various associated nervous complaints are described by the patient including insomnia, anxiety, palpitation, blurring of the vision, mucous colitis, and headaches. (e) One case report exists in the literature of the disappearance of the premenstrual breast symptoms in one breast after the destruction of the thoracic sympathetic of that side.

8. *A local state of vascular congestion is a prominent feature of the painful breast.*— (a) The gross appearance of the painful breast before menstruation with its hyperemia of the areola, venous dilatation, and increased weight alone suggests hyperemia. (b) The histological signs of this vascularity may be demonstrated in the "edema" of the lobule. (c) The relief afforded by the onset of menstruation is usually too rapid to be explained as the result of epithelial regression. (d) The sudden appearance of pain and swelling in the middle of the cycle in certain cases cannot be ascribed to epithelial proliferation. (e) Simple support of the breast often causes considerable amelioration of symptoms. (f) In one case described with pain and hypertrophy, petechial hemorrhages occurred regularly before menstruation in the skin about the areola.

9. *The coincident gynecological lesions and menstrual disturbances have a possible significance as evidence of an associated vascular congestion and tissue edema in the pelvis.*— (a) The common pelvic lesions are classifiable as adnexal inflammation, parametritis, retroversion, and cervical infection. (b) The onset of pelvic symptoms and breast pain after marriage, abortion, or pelvic infections is significant of parametrial congestion or inflammation. (c) The scant menstruation may be regarded as the effect of the secondary fibrosis in the pelvis described by many writers as the end-result of chronic pelvic congestion. (d) The edematous, cystic, and fibrotic ovaries may have a similar cause.

One may offer the following provisional conclusions on the cause and nature of the painful, diffusely nodular type of mastitis as follows:

1. The ovarian hormone is certainly a necessary factor, but it has not been possible by present laboratory methods to demonstrate any specific abnormality of ovarian or anterior pituitary function. It is, however, possible that refinements in technical methods may eventually reveal a definite endocrine disturbance.

2. The conception of the disease as primarily a vascular disturbance with changes occurring in the interstitial tissues of the breast based on abnormal nervous stimuli explains many of the clinical aspects of the disease. Such a view can only be accepted with caution, however, because it requires the assumption of a physiologic mechanism yet largely undemonstrated.

B. BREAST HYPERTROPHY OCCURS IN AT LEAST TWO FORMS

1. In one group in which there is a simple painless enlargement of the breasts of relatively uniform consistence an endocrine factor is clearly prominent. This includes the hypertrophy developing in childhood and in old women in the presence of the specific
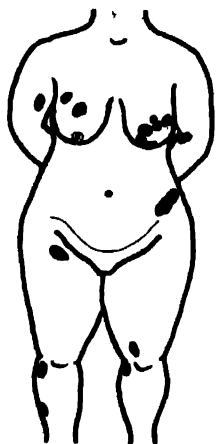
Fig. 1100.

Fig. 1100.—Relapsing febrile nodular nonsuppurative panniculitis, showing the distribution of the lesions and the degree of involvement of the breasts.

Fig. 1101.—Appearance of patient on admission, showing multiple areas of nodular nonsuppurative panniculitis of the breasts. (Binkley—J. A. M. A.)
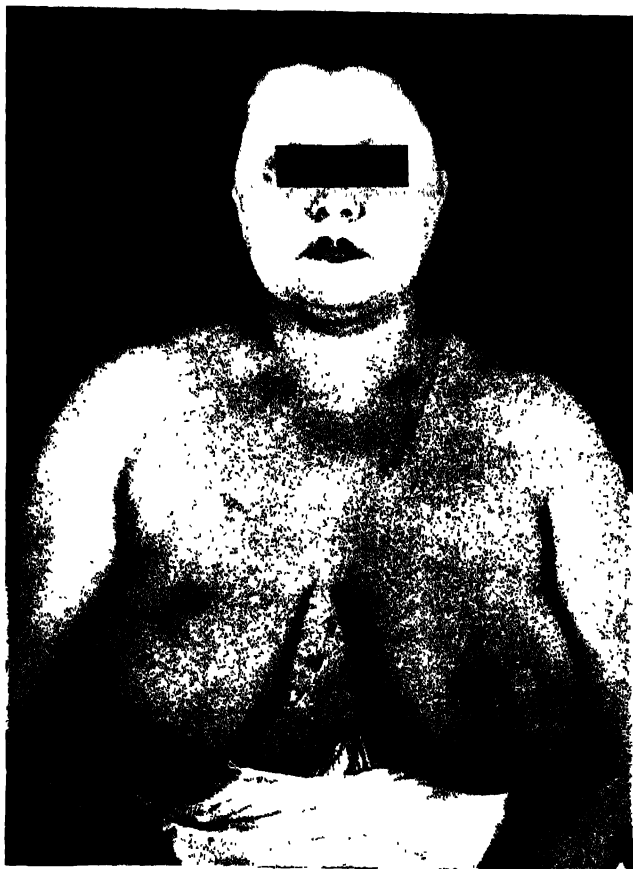
Fig. 1101.

ovarian neoplasms, such as the granulosa cell tumors and teratomas. Breast swelling has also been observed in the presence of persistent corpus luteum and follicle cysts and ascribed to a polyhormonal amenorrhea. Breast hypertrophy after hysterectomy may, in some cases, have a similar basis.

2. The painful hypertrophies of this study were not of this type and resembled closely the tender nodular breasts, both in regard to their physical characteristics and the conditions under which they occurred. Hormone studies of a series of these cases gave normal blood estrin values, rates of monthly excretion of estrin a little higher than in the cases of the painful breast, but still probably within normal limits, and no increase in prolan excretion. X-ray of the ovaries led to a disappearance of the pain and to a reduction in the size of the breasts but the use of ovarian hormone by mouth or hypodermic was ineffectual. The coincident pelvic lesions and the incidents associated with the onset of the

breast enlargement were in general the same as those found for the painful breast.

The conclusions in regard to the causes of this type of hypertrophy must be similar to those for the painful, nodular breast.

C. ABNORMAL SECRETION FROM THE NIPPLE

The local physical characteristics as well as the conditions under which abnormal nipple secretion occurs seem to distinguish it somewhat from the two preceding groups: the average age of these patients was higher; the proportion of women with preceding pregnancies was much greater; menstrual disturbances were more frequent, particularly in the form of delayed menstruation; the average daily excretion of estrin was lower; the secretion did not disappear at once after x-ray of the ovaries.

In many cases, however, the characteristics of the painful breast were present, notably the cyclical pain and swelling, the diffuse nodularity and certain coincident pelvic lesions.

It is concluded that the cases with abnormal secretion are a heterogeneous group, the following representing a possible classification of these.

1. Cases with a non-specific discharge, serous, sanguineous or purulent, from local disease of the larger ducts.

2. Cases reported in the literature with a definite nervous factor either in the form of direct stimulation of the nipple, or a central nervous system disease, such as tabes dorsalis or syringomyelia.

3. Cases reported in the literature with definite evidence of endocrine disease, such as the instances of amenorrhea with follicle or corpus luteum cysts. To this group may belong the cases of temporary secretion in the early menopause, theoretically ascribable to the sudden decrease in ovarian activity or the increased function of the anterior pituitary.

4. In a large group of cases one is forced to maintain the alternative theories noted for the other two types of breast disease, namely an as yet undetermined variety of endocrine disturbance or a little known form of neurovascular disorder.

While nonmalignant tenderness of the breasts is usually due to endocrine disturbance affecting the secreting apparatus, it may occasionally be caused by *nonsuppurative panniculitis*, pictured in Figs. 1100 and 1101. A case of this disease was reported in detail and the literature reviewed by Binkley, from whose article came these illustrations.

CHAPTER XVII

THE LOWER INTESTINAL TRACT IN RELATION TO GYNECOLOGY

By H. S. Brookes, Jr., M.D.

The close anatomic and symptomatic relation between the lower intestinal tract and the female generative organs necessitates the consideration of this portion of the intestinal tract, particularly the anorectal region, in the diagnosis and treatment of gynecologic affections.

The accurate interpretation of lower pelvic discomfort requires information as to the condition of the immediately adjacent bladder and rectum as well as of the genital tract. The location of the bladder and urethra causes them to be palpated in the regular vaginoabdominal examination, and thus any existing tenderness or induration is found and leads to special urinary-tract investigation. As the rectum lies far back in the pelvis, it is missed in the vaginoabdominal palpation—and the rectal condition causing or aggravating the patient's distress is likewise missed. The result is a mistaken or partial diagnosis and inadequate treatment.

The objectives of this chapter are: to call attention to the importance of rectal palpation in women coming with pelvic symptoms, to indicate the cases requiring further rectal investigation, to give an idea of the further methods that may be employed, and to assist in the care of minor rectal conditions which the physician may wish to handle.

History

Rectal symptoms as described by the patient are very helpful in some cases, while in others they are vague and uncertain. For example, the majority of patients diagnose every rectal condition as "piles," and it is up to the physician to determine whether the "slight attack of piles" represents a simple varicosity or an anal dermatitis or an advancing rectal cancer.

Examination

Rectal Palpation.—When a patient comes with pelvic symptoms, the examination to determine the cause or causes of those symptoms should include rectal palpation of the posterior part of the pelvis as well as vaginoabdominal palpation of the middle and anterior portions. Simple rectal palpation, before removal of the glove after the vaginoabdominal and speculum examinations, will give factual knowledge of the important hemorrhoidal area (where chronic irritation may cause much distress or give rise to a new growth) and of higher rectal and perirectal conditions.

To those not familiar with the maneuver, it is surprising how much help rectal palpation gives in outlining a mass in the cul-de-sac and in determining the facts in regard to fluctuation, nodulation, uterine or adnexal attachment, parametrial involvement and rela-

tion to the pelvic wall. Rectoabdominal palpation may aid materially in clearing impor-
tant items which remain uncertain in spite of careful vaginoabdominal palpation.

Rectal palpation of the posterior wall of the pelvic cavity enables identification of
those cases in which the pelvic distress is due to arthritis or neuritis in the coccygeal area
(coccygodynia) or to neuritis involving the sciatic nerve or sacral plexus (Fig. 244). Back-
ache interpretation requires internal palpation of the posterior part of the pelvic cavity
and of the posterior pelvic wall, as well as localizing palpation externally of the lumbar
and sacral areas (Figs. 171 and 284). For combined internal and external palpation of the
coccyx and sacrococcygeal joint (Fig. 283) the patient is changed from the dorsal to the
semiprone position (Sims' position), on the right or left side as preferred. With the com-
bined use of the finger inside and the thumb outside, the coccyx and lower sacrum can be
outlined and points of tenderness accurately located. Thus it can be determined whether
the discomfort is due to arthritis, with the tenderness limited to the sacrococcygeal joint
and much pain on movement of the joint, or to neuritis, with tenderness extending over
the whole region, or to inflammation, with tenderness limited to the infiltrated area, or to
deformity (from injury or disease) so marked as to interfere with rectal function or cause
painful pressure on some nerve.

There are certain things which diminish the pain or discomfort of rectal palpation.
The gloved finger should be well lubricated and the introduction should be made gradually,
the patient at the same time being told to ''bear down'' slightly so as to relax the sphincter
muscle. The strong contraction or ''spasm'' of the muscle blocks the opening, but with
steady even pressure and the patient ''bearing down'' the muscle gradually relaxes. Of
course, any painful condition aggravates this sphincter spasm, and in such cases a local
anesthetic application may be needed, such as the 20 per cent cocaine solution mentioned
under Instrumental Examination.

Instrumental Examination.—The necessity of instrumental examination of
the rectum will be determined by the findings on rectal palpation and by the
patient's history of her trouble. If there are rectal symptoms which the digital
palpation of the rectum does not account for, then investigation with instru-
ments is advisable. Following are listed those ordinarily used, with methods
of use.

The **anoscope,** such as Kelly's (Fig. 1102), is used for examination of the anal canal
by direct light, or by light reflected from a head mirror. It is a short speculum, one and
a half to two inches long; and after being lubricated, it is inserted to its full length, and
the obturator removed. As the tube is slowly withdrawn, the canal is inspected carefully,
observing the appearance of the mucosa, and looking for hemorrhoids, internal openings
of fistulae, and fissures.

The **proctoscope** (Fig. 1102) is a longer instrument than the anoscope, and is used for
examining the upper rectum. It is about six inches long; and can also be illuminated
either with reflected light by the use of a head mirror, or by direct light by using a procto-
scope with a special electric light attachment. Another special attachment is a glass cap
fitted so that air can be forced in with a hand bulb and the rectum thus inflated (Fig.
1102). With the patient in the semiprone position, the lubricated instrument is inserted
gently, the obturator removed, and the condition of the mucosa and the valves of Houston
is noted. A local anesthetic is seldom necessary for a proctoscopic examination, but may
be needed in cases of stricture or other painful condition. Examination can usually be
made after a pledget of cotton saturated with 20 per cent cocaine solution has been in-
serted and allowed to remain for several minutes. If the rectum contains feces, a small
enema of boric acid solution will usually clear it.

The **sigmoidoscope** (Fig. 1102) is an instrument ten or twelve inches long which can
be illuminated with reflected light or electric light attachment. The Tuttle and Yeomans
types of sigmoidoscopes are very satisfactory, the former having a small electric light at
the distal end and the latter having the light near the proximal end. The proximal end
can be closed with a glass cap to which a hand bulb can be attached for forcing air into
the rectum. The electric current comes either from dry cells or by attachment to the reg-

ular electric light system with a reducer. Sigmoidoscopic examination can usually be done without a local anesthetic; but in slightly painful conditions of the canal, application of 20 per cent cocaine solution to the surface will relieve the pain and permit examination. In certain cases with very painful conditions, and in apprehensive or neurotic patients, a general anesthetic will permit a satisfactory examination, which otherwise could not be made. Besides the dangers common to a general anesthetic, an added danger is the greater possibility of injury to the intestine when the patient is unable to complain and thus limit the extent of the pressure or distention.

In the preparation of the patient, if the rectum contains feces, lavage with boric acid solution will usually empty the rectum and sigmoid. When the large intestine is atonic, more elaborate preparations are necessary. In these cases, the day before the examination, the patient should take three drams of magnesium sulphate; and three hours before coming to the office a large saline enema should be taken, followed two hours later by an injection of one-half pint of clear water containing one dram of glycerin.
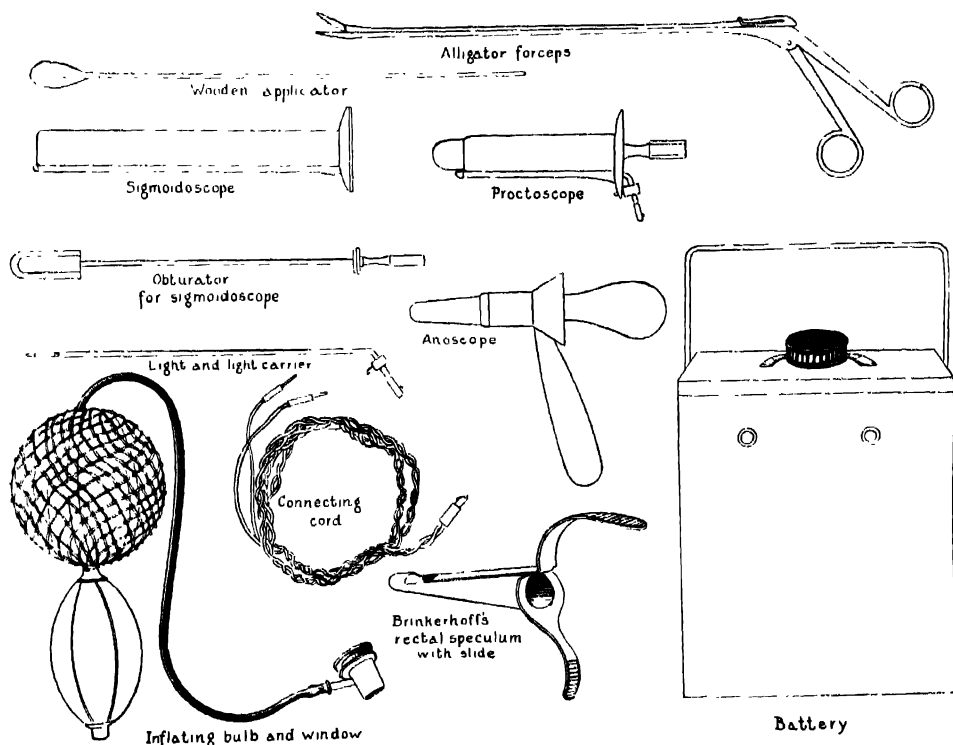
Fig. 1102.—Articles for instrumental examination of the rectum, and also for treatment.

In arranging the patient for the sigmoidoscopic examination, she is placed in the knee-chest position, unless she is particularly hypersensitive or it is difficult on account of physical disability. The index finger is inserted first to lubricate and dilate the anal canal. The lubricated sigmoidoscope is passed while the patient strains as instructed. After the anal canal has been passed, the handle is gradually lowered and pushed forward until the end of the instrument has reached the middle portion. The obturator is removed, and one can see the margins of the three or four valves of Houston. As the tube is passed on, these valves and the rectum are inspected by direct vision, the instrument being gradually raised and pushed onward to the sacral promontory where resistance may be met in the form of a well-developed fold of mucous membrane. This can be effaced with the end of the instrument, which is passed on into the sigmoid flexure. Areas of congestion and ulceration should be looked for. These may be evidence of simple inflammation or irritation, or signs of more serious trouble, such as tuberculosis or carcinoma.

X-Ray Examination.—The ordinary diagnostic methods should be used before the patient is referred for x-ray examination. Digital and instrumental examinations will differentiate the large majority of lesions of the rectum and lower half of the sigmoid far more accurately than the x-ray can. This does not detract from the valuable assistance rendered by the x-ray in certain conditions. It is usually advisable to ask for a complete gastrointestinal series whenever the symptoms are not accounted for by the ordinary examination. After giving bismuth or barium preparations, the roentgenologist, at stated intervals, makes fluoroscopic examinations, or stereoscopic or simple photographs. These examinations will outline the form and position of the colon, detect displacements and points of chronic intestinal obstruction; differentiate mechanical from physiologic delay, locate strictures and diverticula, as well as be of great value in the diagnosis of appendicitis. X-ray examination following a barium enema will show the length and mobility of the pelvic colon, obstructions by adhesions or strictures or new growths, and the efficiency of the functioning of the distal colon and rectum. After injecting fistulae with lipiodol or bismuth paste, x-ray films will outline the tortuous tracts.

DISEASES OF THE ANORECTAL REGION

The following diseases will be considered in the order mentioned:

Pruritus ani.	Hemorrhoids.
Fissure in ano.	Stricture.
Fistula.	Proctitis.
Anorectal abscess.	Foreign bodies.
	New growths.

Pruritus Ani

Pruritus ani, of all rectal conditions, is probably the most annoying to the patient and the most stubborn in responding to treatment. Because it is rather common and appears so simple, those who are afflicted with it cannot understand why it is not easily cured.

It is a condition of the skin about the anus characterized by annoying or severe itching, and tending to become chronic and to recurrence. At the beginning there may be no gross changes in the appearance other than congestion. In an effort to relieve the itching the patient scratches, thus producing a chronic inflammation; and the abrasions and fissures become portals of entry for the bacteria, so that an infective process is superimposed. In chronic cases the skin appears thickened, pale from loss of pigment, and moist and abraded, due largely to the scratching. In old cases the skin becomes parchmentlike, smooth and leathery, as a result of the subcutaneous fibrosis. The terminal nerve endings may be compressed by this new fibrous tissue and so aggravate the itching. The changes occur especially in the midline, anterior and posterior to the anus, and frequently involve the vulva; when a large area is involved, it resembles eczema.

Etiology.—Different writers attribute this disease to various causes; some believe that it is a primary disease in itself, and others say it is a symptom of some underlying condition.

Murray says it is an infection caused by the *Streptococcus fecalis;* but others think the pruritus occurs first, and the infection is secondary, caused by the scratching. Diet, physical exercise, and certain constitutional diseases such as diabetes, allergy, and endocrine imbalance, seem to have some relation to it. Hill divides the cases of pruritus into two classes. In his first group there is a coexisting rectal disease which keeps the perianal skin moist with discharges; the skin becomes soggy and soft, and pruritus results. In the second class are the cases in which no evident cause can be found; they are apparently

due to infection by the streptococcus or other intestinal flora. Intestinal worms may cause itching in the anal canal or at its orifice. Pediculi or fungus organisms may be responsible. The presence of any condition which would prevent proper cleansing of these parts may be a factor. Local congestion is usually noticed in pruritus, and hemorrhoidal veins may be an etiologic factor. Foci of infection in the teeth, tonsils and other organs should be looked for. Diseased organs, far removed from the site of itching, may be the etiological factor. Also there may be more than one source of the trouble.

Symptoms.—The chief symptom is a severe, tantalizing, local itching, which may be intermittent or continuous. It may be confined to a small area or spread over the entire perianal region. It is usually worse at night, causing loss of rest and sleep, and more noticeable in warm weather. The nervous strain and physical suffering may make the patient unfit for ordinary duties.

Diagnosis.—The diagnosis can usually be made easily, based on the history and the examination. The early cases may have only slight skin lesions; but in more advanced cases the skin may be dried, reddened, wrinkled, and thickened, or blanched, moist, and macerated.

Examination of the parts is made for worms or pediculi, ulcer, fissure, or suppurating sinus. Prolapsing or ulcerated hemorrhoids should be looked for, and a rectosigmoidal examination should be made for the source of any pathologic discharge. A thorough general examination is advisable in order to discover diseases in the various organs and tracts, foci of infection, and general constitutional diseases. Joslin states that the pruritus in diabetes is more likely to be general; but, if local, it usually affects the vulva.

Treatment.—The treatment depends upon the etiology, as to whether the condition is due to a local infection or to a coexisting rectal or constitutional disease. The patient should be treated for any general constitutional disease and for any local rectal conditions, such as external hemorrhoids with their ragged tags of redundant skin which prevent proper cleansing of the parts, or for conditions causing the formation of irritating mucus, such as prolapsing internal hemorrhoids or mucous membrane. Treatment should be given to superficial ulcers and abrasions of the anal canal and to polypi, fissures, and fistulae. It is sometimes surprising to note the quick relief obtained in pruritus by the cure of a coexisting small lesion of the anal canal.

In the **general treatment** attention should be paid to the diet, limiting tea and coffee, prohibiting alcoholic beverages, reducing sweets, allowing small amounts of meats, and encouraging the drinking of water freely, especially alkaline waters. Cotton or linen underwear should be worn and also an anal pad of absorbent cotton, which should be changed frequently. A powder may be dusted on the cotton to help keep the parts dry, such as:

		Gm. or c.c.
℞	Phenol _____ _____	0.60
	Amyli pulv. _____	15.
	Pulv. zinc oxid. q. s. ad. _____	30.

The patient should be cautioned against scratching; and, if necessary, she should wear white cotton gloves at night to prevent scratching while asleep. Sedatives may be used for insomnia; but it is best not to use opium derivatives, because of the habit-forming danger in such a chronic condition. Sodium bromide, veronal, allonal, and similar sedatives may help in producing a restful sleep. After each bowel movement the parts should be cleansed with cotton wet in warm water, followed by witch hazel, and blotted, not rubbed, dry with cotton.

In the local treatment applications are to be varied with the condition of the skin. Very often dry applications are more effective than ointments; but if the skin is inflamed, painful, and itching, soothing applications should be made. The following combination is helpful and should be applied as required to control itching:

		Gm. or c.c.
℞	Phenol liq.	4.0
	Calamin praep.	8.0
	Zinc oxid.	16.0
	Glycerin	16.0
	Liq. cal. hydrox.	30.0
	Aq. ros.	240.0

Applications of 0.5 per cent yellow oxide of mercury give considerable relief in some cases. For a dry application the following powder is helpful:

		Gm. or c.c.
℞	Boric acid	8.0
	Zinc stearate	8.0
	Talcum	30.0

In older cases in which the skin is tough and leathery, Adler applies a saturated solution of silver nitrate, using first a 10 per cent solution of cocaine if there are any abrasions present. The silver application is repeated every four or five days until the dead epithelium has been removed. At each visit after the application the exfoliating layers of epithelium are removed, the anal region is cleaned with cotton, and any excoriated areas are cleansed with tincture benzoin comp. This is continued until the skin regains its original color and elasticity.

X-rays have been used extensively, but with relatively poor results. A small number of patients have apparently been cured. Temporary relief has been obtained in many cases. Some use fractional and others, intensive doses.

Ultraviolet rays are theoretically a good form of treatment, because of the claim for germicidal action of the rays; but, practically, the results have been disappointing so far.

Ionic medication is advocated by Rolfe, of Boston. It is a form of electrical treatment by which the ions of certain salts having marked antiseptic properties, such as those of zinc, iodine, or mercury, are driven into the deeper layers of the skin by a direct current of electricity of low voltage. The treatment is based on the fact that the disease is an infection of the perianal skin caused by one of the streptococcus groups. Such treatment requires special apparatus and experience. It has proved successful in some cases, and has given considerable relief in others.

Vaccine treatment is applicable only to those cases of pruritus ani due to infection, usually by the *Streptococcus fecalis,* according to Murray. An autogenous vaccine is made from the surface of the cleansed pruritic skin, and frequent injections are given, beginning with small doses and working rapidly up to massive doses. Murray apparently had more success with this method than other workers have had.

Subcutaneous injections of alcohol locally have been used for their destructive effect on the network of fine terminal sensory filaments. With the patient in the lithotomy position under a light general anesthesia, 95 per cent grain alcohol is injected with a short fine needle. The needle is plunged vertically through the skin, and from 2 to 4 drops of the alcohol are injected in the subcutaneous tissue at each puncture. Punctures are made about ¼ of an inch apart. There is very little after-soreness, and the itching stops immediately. There is numbness of the perianal skin, but there is no disturbance in the act of defecation. A few patients are apparently cured, and some are relieved for several years; but in many, the itching returns in from six to twelve months. These patients can be reinjected, thus gaining relief for another period.

Yeomans advocates the use of benacol, a nontoxic, highly anesthetic, moderately antiseptic preparation. About 2 c.c. of benacol are slowly injected subcutaneously at the periphery of the pruritic area, the solution being distributed in a fan-shaped area to the anal margin. This injection takes in a single quadrant of the perianal tissues, beginning in the quadrant in which the itching is most intense. Treatments are repeated at intervals of two or three days until the whole area is injected. This course of injections may be repeated at intervals of five days until the itching ceases.

In those cases of chronic dermatitis in which the vessels are obstructed and the nerve endings ensnared, after all exciting causes have been investigated and treated without relief, operation is resorted to in order to free the entangled nerves and constricted vessels from subcutaneous adhesions.

Fissure in Ano

A fissure is a break in the mucous membrane near the anal margin, within the grasp of the sphincter. It occurs most commonly in the midline, anteriorly or posteriorly, and is usually superficial; but, occasionally, it is deep enough to expose the muscle fibers. The fissure has an elliptical appearance; but, on full exposure, may appear as a round ulcer. It is almost always single, and when multiple, it may be of specific origin (syphilitic, gonorrheal, or tuberculous).

Etiology.—Constipation is considered the principal cause, the mucous membrane being torn by the forced passage of hard fecal masses. The passage or introduction of foreign bodies may traumatize the mucosa. Ball and Gant think that typical fissures are produced also by the tearing of the crypts of Morgagni; this is brought about by the deposit of small fecal masses in these pockets, followed by pressure on them at bowel movement. This causes a tearing of the valves at the edge of the crypts, the laceration gradually extending with each passage. Other predisposing factors are any conditions which weaken the tissues and render them liable to abrasion, such as polypi, pruritus, trauma, or any type of inflammation about the anus.

Symptoms.—In superficial fissures there is usually a sharp shooting pain during defecation, lasting only a short time afterward. With deeper fissures there is the same sharp pain with defecation, followed by a dull, dragging pain or ache, lasting several hours, or in some cases being constant. Because of the close association of the nerves supplying the anal canal and the genitourinary organs, there may be reflex or referred symptoms to one or more of these organs which might lead to confusion in the diagnosis.

Diagnosis.—The symptoms are so typical that a correct diagnosis can usually be made from the history alone. On separating the buttocks and asking the patient to strain, the fissure can usually be seen in the midline, anteriorly or posteriorly. Or one may see a prominent skin tab, which frequently has a fissure situated at its base (often referred to as a sentinel pile). Digital examination to detect complicating conditions is likely to be difficult, because of the local pain and muscular spasm. However, local anesthesia is usually sufficient to relieve the pain and spasm, and permit the examination.

Treatment.—Prophylactic treatment consists in making it a habit to have a daily bowel movement, keeping the parts clean, and taking proper care of other rectal conditions. Palliative treatment should be used in simple cases where the ulcer is superficial; and it may be tried also in the more severe cases, where the patient frequently has the morbid fear of any operative procedure.

Relief is occasionally secured by palliative treatment in the more severe cases; and, if not, the patient has had the opportunity to see the futility of delay and becomes more cooperative. Rest is important; and the bowels should be regulated by diet and, if necessary, some form of mineral oil should be given by mouth once or twice a day. Careful injection of from 2 to 4 ounces of warm cottonseed oil at night through a soft rubber catheter will soften and help lubricate the movement. Constipated bowel movement is injurious and painful, and liquid movements are very irritating.

If the pain is very severe, an ointment of cocaine or morphine, 5 to 10 grains to the ounce, may be applied. Applications of 15 per cent ichthyol in glycerin every four or five days are often helpful. The pain is relieved first by applying a 20 per cent solution of cocaine directly to the fissure, stretching the sphincters moderately with the fingers, and then applying the ichthyol on a small pledget of cotton and allowing it to remain for several hours.

Touching the fissure with silver nitrate is a common method of treatment, with rapid healing in some cases. Digital dilatation under general anesthesia will usually give temporary relief, and, at times, permanent cure. Frequently, there is a severe pain after this treatment, which can usually be relieved by inserting a suppository, such as belladonna and opium.

Injections of quinine and urea hydrochloride are used with good results. A freshly prepared 5 per cent aqueous solution of quinine and urea hydrochloride is injected one-eighth inch below the edge of the fissure. Two minims are deposited beneath the skin; the needle is then advanced, and a total of 15 minims is gradually injected. The solution is irritating, and may cause the patient severe pain for a few minutes after the injection.

Operative treatment consists of incision or excision of the fissure. While operative treatment will usually completely disable the patient for a few days, it will shorten the time of partial disability and suffering, and be more certain of preventing recurrence.

Fistula

A fistula is a chronic suppurating canal having one or more external openings about the anus, or an internal opening into the rectum, or both. A complete fistula has both an internal and an external opening. An incomplete fistula has only one opening, either external or internal. If the opening of an incomplete fistula is outside the anorectal line, it is called a blind external fistula; or if within the rectum, it is called a blind internal fistula. Usually there is only one internal opening, but there may be several external openings.

Etiology.—Most fistulae develop from abscesses; and, in the rare cases with no previous abscess history, they are due to organisms gaining entrance through the abrasions of the mucous membrane, such as an anal fissure. The failure of a complete fistula to heal is due to the constant passage of fecal material and gases through the tract. In a blind internal fistula there is also passage of fecal material into the sinus, healing being prevented by the imperfect drainage. The nonhealing of blind external fistulae is due to the constant motility of that area from respiratory movements, action of the bowels, and movement of the sphincter muscles. Tuberculosis and syphilis are also causes of fistulae.

Symptoms.—Ordinarily, there is so little pain that a patient may not know she has a fistula, or there may be a dull ache or feeling of discomfort. When the external opening closes, as it often does, especially in a blind external fistula, there may be considerable pain until the abscess again opens and the

pressure is relieved. With complete fistulae there is likely to be more pain when the internal opening is large, thus allowing the passage of fecal material which keeps up the irritation and produces the extensive burrowing. When the internal opening is small, there is little irritation unless the stools are liquid.

Diagnosis.—There is usually the history of an abscess that has opened spontaneously or has been incised. The external orifice may be a slit in the skin, or an ulceration of varying size, or may be a small projection or a cicatricial depression. A probe can often be passed through the fistula from the external to the internal opening; but if it does not pass readily, the internal opening can often be located by inserting the finger into the rectum. The internal opening may be located also by injecting through the external opening a solution made up of two parts of methylene blue and one part of hydrogen peroxide. The gas liberated by contact with the discharges carries the methylene blue to all ramifications of the tract, and with a speculum one can watch the point from which the solution escapes internally. X-ray pictures following the introduction of bismuth paste or lipiodol, give one an idea of the number and direction of the sinuses.

Tuberculosis is to be suspected when the fistula has a large, irregular-shaped opening with bluish-tinted undermined edges. Microscopic examination of an excised specimen from this area will complete the differentiation.

Treatment.—Operation is the only treatment that really offers reasonable hope of cure in fistula. However, because of the slight discomfort caused by most fistulae, and the patient's fear of an operation and of incontinence, many will insist on other than operative treatment. The external opening should be kept free for proper drainage, by dilatation, if necessary, by hot packs and sitz baths, and by keeping the feces well formed. Injections of bismuth paste have been used with indifferent success. Beck's bismuth paste is composed of one part of bismuth subnitrate and two parts of vaseline; this was formerly commonly used in the treatment of fistula in ano. Gant says: "This treatment is tedious, usually fails, and when force is used bismuth sometimes ruptures the main tract, or gets caught in branch sinuses where it later causes irritation." He uses bismuth only in those cases which, for one reason or another, are inoperable.

In operative treatment the fistula may be incised or excised, or treated with an elastic ligature which gradually cuts through.

Anorectal Abscess

The perirectal tissues are frequently infected due to traumatism caused by hard stools or instrumentation. It is surprising that infection of the perirectal tissues does not occur more frequently. This may be explained by the fact that pus-forming organisms are not usually present in the stool, and that there is an extensive protective blood supply. Damage to the mucosa permits entrance of the organisms to the deeper tissues, with possible abscess development. If the abscess forms above the levator ani muscle, it will be a superior pelvirectal or a retrorectal abscess. If the abscess forms below the levator ani muscle, it will be an ischiorectal or a postanal abscess.

Pain, tenderness, swelling, and fluctuation will indicate the location of the abscess. The two important points of treatment in pararectal abscess are the locating and division of the internal opening, and institution of adequate drainage.

Hemorrhoids

Hemorrhoids, or piles as they are frequently called, are considered the most common disease of the rectum. They are varicose swellings involving the veins and capillaries of the mucosa and submucosa of the anal canal, and are characterized by a tendency to bleed.

Etiology.—There are many predisposing factors, such as age, sex, occupation, habits, diet, cathartics, enemas, and complicating affections of the bladder, uterus, liver, heart, and kidneys.

Hemorrhoids are rare in infancy, being most frequently found at middle age. They are said to occur twice as often in males as in females. This may possible be accounted for by the fact that being accustomed to the regular menstrual flow, women do not attach as much importance to rectal hemorrhage as do the men. A sedentary life, when muscles become atrophied and relaxed with impairment of general health, has much influence in causing piles. On the other hand, those engaged in heavy work, involving great straining and lifting, are also subject to piles. Improper diet, by causing constipation with its resultant straining, drastic cathartics, and affections of the various organs, are factors in the production of hemorrhoids. Anything causing pressure and thus interfering with the return circulation, such as distended colon, large fibroids, or pregnancy, is very likely to produce hemorrhoids. Piles which develop during the last months of pregnancy will generally disappear a short time after the pressure is removed. The most satisfactory explanation of the basic cause is anatomic, i.e., the erect posture and the absence of valves in the portal system.

Classification.—Hemorrhoids are divided into three main groups: external, internal, and mixed or combined externo-internal. External hemorrhoids are further divided into venous and cutaneous types, the venous types being either thrombotic or varicose and the cutaneous types being redundant or hypertrophic tags.

EXTERNAL HEMORRHOIDS

External Thrombotic Hemorrhoids are swellings, varying in shape and size from that of a pea to that of a small English walnut, occurring at the anal margin. They are usually single.

Thrombotic piles usually appear suddenly, due to the rupture of a vein during coughing or straining, or from direct injury to the anal region. Heavy lifting, violent exercise, straining at stool, or injury caused by digital or instrumental examination, may be responsible for the development of a thrombus.

At first there is a pricking or uneasy feeling at the anus; but later, as the bleeding from the ruptured vessel continues, the swelling becomes larger, the skin tension is increased, and the patient complains of the pain and swelling. The pain is often so severe as to prevent sleep in any position, but it usually subsides in two or three days.

The **diagnosis** is easily made from the history of sudden onset, hypersensitiveness, acute pain, and the finding at the anal margin of a firm oval mass of bluish color.

The **treatment** may be palliative or operative. Palliative care consists of rest in bed, softening of the bowel movements, and applications of hot or cold packs or of a soothing lotion or ointment, such as the following:

	Gm. or c.c.			Gm. or c.c.
℞ Liq. plumbi subacetatis__	16.0		℞ Ung. stramonii _____	6.0
Tinc. opii _____	10.0		Ung. belladonnae _____	10.0
Aq. dest. q. s. ad. _____	120.0		Ung. acidi tannici _____	15.0

The above palliative treatment is applicable only in the small thrombi, operation being preferred in the large tumors or because of the slow response to palliative measures of the small thrombi.

In operative treatment the clot is enucleated under local anesthesia, and the wound is packed with a strip of gauze for twenty-four hours. Some prefer to remove the mass in toto, by an elliptical incision of the skin about the base of the tumor, and then close the wound with catgut sutures.

External Varicose Hemorrhoids.—This type is not very common, and appears as tortuous or pouchlike dilated veins near the anal margin. They, alone, cause little discomfort other than a sensation of fullness and uneasiness about the anus during defecation.

The **treatment** is usually palliative. They may be reduced in size by rest, cold packs, and some astringent application. The bowel movement should be soft, and the conditions responsible for the persistent straining must be corrected. It is seldom necessary to operate for this condition alone, as it causes very little trouble; but if one is operating for another anorectal disease, these enlarged veins may be removed with the Paquelin cautery or by dissection or ligation.

External Cutaneous Hemorrhoids.—These are not vascular piles, but may be an enlargement or thickening of one or more of the normal folds of skin about the anus, or may consist of a skin tab with a broad base or a pedunculated projection. They may be secondary to cancer, fissure, stricture, or other diseases accompanied by a discharge which keeps the perianal skin irritated. This type seldom causes much trouble, except the greater care necessary to keep the parts clean. Pruritus may develop from insufficient cleansing.

Treatment.—Cleanliness of the parts, regulation of the bowels, and, if the condition is acute, rest in bed and cold applications, will give relief. Also applications of the calamine and phenol lotion, previously mentioned, or of a 1 per cent cocaine solution, if needed.

Operative treatment cuts short the inflammatory period and prevents the possibility of recurrent attacks. Under local anesthesia this type of hemorrhoid can be easily removed with a pair of curved scissors, permitting the wound to heal by granulation.

INTERNAL HEMORRHOIDS

Internal hemorrhoids are vascular swellings situated in the lower rectum, just above the anorectal line. Typically, they consist of a conglomerate mass of dilated venules with chronic inflammatory changes in the connective tissue stroma, and a covering of rectal mucosa which is more or less diseased.

Etiology.—Some patients give a history of an inherited structural weakness. Hemorrhoids in later life are part of a degenerative change affecting all the tissues of the body. The sphincters are thin and atonic, and proper muscular support is lacking. The upright posture and lack of valves in the portal vein into which the hemorrhoids drain are anatomic factors. Increased abdominal pressure and straining at stool caused by constipation are predisposing causes.

Symptoms.—Bleeding and protrusion are characteristic symptoms. Bright red blood is passed in smaller or larger quantities at bowel movement. Protrusion is usually a late symptom. Pain is not a characteristic symptom, although smarting or throbbing may occur at defecation. Prolapsed internal hemorrhoids may become inflamed, thrombosed, and strangulated, and are then very painful and tender.

Diagnosis.—With careful examination one should be able to differentiate internal hemorrhoids without difficulty. The area is inspected, the patient, in the Sims position, being instructed to bear down while the buttocks are separated by the examiner. The mucosa protrudes, exposing the piles and possibly other associated conditions, such as fissures. Digital examination is of little help in the diagnosis of hemorrhoids unless there is thrombosis; but hemorrhoids are often secondary to conditions in the bowel above, and digital examination will aid in the discovery and diagnosis of such complications. Instrumental examination by the use of the endoscope or proctoscope is of great help, for the longer instrument permits examination of the upper rectum and sigmoid, and on its withdrawal the hemorrhoids prolapse into the lumen.

Treatment.—Palliative treatment is sometimes successful in early cases, and may be tried in cases in which the hemorrhoids never protrude. It may be used also where there is contraindication to operation. Rectal injection of one ounce of olive oil before retiring will relieve constipation and lubricate the fecal mass so that it is passed without injury to the hemorrhoidal tumors. Ointments may prevent inflammation and relieve pain. They should be applied immediately after bowel movement so as to come in direct contact with the tumors, and help in the reduction of the mass. Zinc oxide ointment is useful when applied on toilet paper over the index finger, or by inserting the perforated tip of a collapsible tube and compressing the tube, or the ointment of stramonium, belladonna, and tannic acid may be used in collapsible tube.

If there is much pain, astringent and analgesic ointments are used as follows:

	Gm. or c.c.			Gm. or c.c.
℞ Cocaine hydrochloride	0.5	℞	Morphine hydrochloride	0.6
Menthol	0.6		Ext. belladonnae	15.0
Adips. benzoinati	30.0		Adips. benzoinati	30.0

Many types of suppositories containing various drugs, such as cocaine, morphine, belladonna, ichthyol, aristol, or adrenalin chloride, have been used, and are further beneficial because their introduction tends at the same time to reduce any piles that have prolapsed.

Injection methods have been greatly exploited and are very helpful in certain cases, but their indiscriminate use in all kinds of cases has caused them to be condemned. More recently the injection method has again become popular as a legitimate form of treatment, when properly used in selected cases. The object of the injection is to set up inflammation in the pile tumor by the injection of an irritant. The resultant inflammatory infiltration produces a gradual obliteration of its vessels without causing a slough. At the present time a 5 or 10 per cent solution of carbolic acid in almond oil, or a 5 per cent aqueous solution of quinine and urea hydrochloride are the solutions most commonly used. They give very good results in many cases. It is best to treat only one or two hemorrhoids at a time, although several may be present. If prolapsed, they should be reduced before treatment is begun. Strangulated hemorrhoids should not be injected until the acute symptoms have subsided. The hemorrhoids are brought into view with a small, conical, fenestrated speculum; a fine-pointed needle is inserted into the center of the hemorrhoid, and ten minims of a 5 or 10 per cent solution are injected. The hemorrhoid becomes swollen and indurated, this induration lasting from ten to fourteen days. During this time the blood vessels of the tumor are obliterated and fibrous tissue develops, causing the vessels to shrink and practically disappear. If the hemorrhoidal tumor is still marked after two weeks, it should be reinjected.

Operative treatment is indicated when other measures fail. Many operations have been devised and suggested for the treatment of internal hemorrhoids, but the ligature and clamp and cautery methods are the ones that receive general recognition.

Stricture

A stricture of the rectum is a narrowing of the lumen. There are two varieties, the annular and the tubular, and either may be congenital or acquired.

Etiology.—The congenital stricture of the rectum is rare, and if present, it is usually associated with abnormalities in other parts of the body. Acquired strictures may be due to chronic inflammatory processes or trauma. Ulcerations heal by granulation, leaving a certain amount of scar tissue. Operative procedures, such as the removal of hemorrhoids, may be followed by stricture if too much of the mucous membrane is sacrificed or if too much of the submucous tissue is removed.

Strictures at the anal orifice may be caused by too free removal of the external skin which in healing becomes so contracted that it will not allow dilatation of the external sphincter. Also, the motility of the muscle is diminished by the scar tissue infiltration. Strictures at the level of the internal sphincter may be due to too free removal of the mucous membrane or to an infective ulceration of this area, following a hemorrhoid operation. Strictures in the rectum proper are usually due to ulceration in the bowel or to infiltration around it. There is also a type of spasmodic stricture caused by worms, irritating discharges, foreign bodies, fracture of the coccyx, and diseased structures adjacent to the anal canal. Syphilis was thought to be the most common cause of stricture, but few of the lesions show local evidence of syphilis, and the serology is negative in a large number of the cases. A disease which has been recognized more frequently in recent years, lymphogranuloma inguinale or lymphopathia venereum, is one of the many factors in the development of inflam-

matory strictures. The staphylococcus, colon bacillus, and streptococcus are frequent causes of inflammatory strictures. New growths within the rectum or tumors pressing from the outside may cause a mechanical narrowing or complete obstruction of the lumen.

Strictures above the internal sphincter are found about five times as frequently in women as in men, occurring in the large majority of women during the childbearing period. The frequency in women may be attributed to perirectal extension of genital inflammation, or to injury in difficult labor from the use of forceps, or from long pressure of the head on the rectum.

Symptoms.—A history of progressive constipation and frequent incomplete evacuations of the bowels, resulting in a great deal of straining and tenesmus, should arouse suspicion of stricture. Other symptoms are passing of ribbon stools, abdominal distention, and griping abdominal pains. Ulceration usually occurs, due to the loading and distention of the colon with fecal matter, resulting in the passage of blood and pus. The general health is impaired, the appetite becomes poor, and there are indigestion and loss of weight.

Diagnosis.—A very large percentage of strictures can be reached for diagnosis by digital examination. One should determine the size, shape, length, and also the extent of infiltration and ulceration about the stricture. The malignant stricture gives the impression of a tumor, feeling much like the cervix uteri through the rectal wall, except that it is nodular and often associated with invagination of the mass. The benign stricture is usually easily differentiated. If it is at the anal orifice, the skin is tightly drawn down and will rarely admit the index finger. If it is at the level of the internal sphincter, there is an annular bandlike stricture; but a stricture above this level gives the impression of passing one's finger into the mouth of a funnel. A positive Frei test is indicative of lymphopathia venereum.

Treatment.—In regard to prophylaxis, proper surgical technic and suitable postoperative care will prevent in most cases the formation of stricture following hemorrhoid and other rectal operations. Treatment depends upon the location of the stricture.

At the anal orifice dilatation causes considerable pain, so that a simple operation is preferred. This consists of a division of the fibers of the external sphincter under local anesthesia, followed later by digital dilatation. Annular strictures near the level of the internal sphincter, if seen early following hemorrhoid operation, can be cared for by dilatation. When seen later, operation is necessary. Strictures at the level of the internal sphincter, or above, are difficult to handle in regard to a cure. Considerable relief can be obtained by gradual dilatation up to three-fourths of an inch, and this may be repeated, as necessary, to maintain a fair-sized opening. Some have obtained results with the use of carbon monoxide snow or diathermy, the former causing a softening of the stricture from edema, the latter by increasing the blood supply in the scar tissue.

In lymphopathia venereum sulfanilamide has been beneficial in many cases. Good results are sometimes obtained from intracutaneous injections of Frei antigen.

Besides the surgical measures, diet and regulation of the bowels are necessary. The patient should have a nutritious, but not too bulky, diet, avoiding spinach and other rough vegetables and, especially, rice. Constipation should be corrected by regular habits and mineral oil, one-half ounce three or four times a day.

Proctitis

Catarrhal inflammation of the rectum may have a common origin with similar conditions of the mucous membranes of other portions of the body; and,

because of the similarity of structures and continuity of the mucosa, the colon, sigmoid, and rectum are frequently involved in the same inflammatory process.

Etiology.—In some people susceptible to certain reflex disturbances, chilling of the body is sufficient to produce an attack of acute inflammation. In others, it is produced by irritating cathartics, or by certain foods or drinks, or by parasites. Foreign bodies or impacted feces can produce slight wounds or abrasions which permit infection of the mucous membrane by the bacteria ordinarily present (colon bacillus, streptococcus, staphylococcus). Other bacteria sometimes found are the dysentery ameba, typhoid and tubercle bacilli, gonococcus, and pneumococcus. The rectal mucosa is very susceptible to irritation by radium, and large doses used in the vicinity, for example, for carcinoma of the cervix uteri, may produce early or late ulceration, with very distressing symptoms.

Symptoms.—Acute proctitis is characterized by sensations of heat, weight, and fullness in the rectum, with aching, throbbing pain, often radiating to the sacrum, down the limbs, and to adjacent organs, such as the bladder. Often there is also a constant desire to empty the rectum, with severe tenesmus. In catarrhal inflammation there is first a hyperemia and outpouring of mucus, leucocytes, and red cells. Later, proliferation and desquamation of the epithelium may take place.

Diagnosis.—In acute conditions the parts are tender, and digital examination is very painful; the parts feel hot, dry, and swollen; and there are congested areas, which bleed very easily when the secretions are wiped away.

Treatment.—In the milder cases diet and rest are often sufficient. A liquid diet, principally of barley water and strained oatmeal gruel with broth (beef, lamb or chicken), is advisable. At the beginning of treatment a large dose of castor oil will rid the bowel of any irritating substance. In more severe cases local treatment should be started to relieve the tenesmus and pain, and to prevent the acute conditions from becoming chronic. Rectal irrigations, by means of a return flow tube, of normal saline or bicarbonate of soda or boric acid solution should be given, with the patient in the knee-chest position. Use one or two quarts of the solution and allow it to run in slowly. After this has been passed, the patient can be examined. The secretions are wiped away, and the involved areas are painted with silver nitrate solution (10 grains to the ounce) or 10 per cent argyrol, or 15 per cent balsam of Peru in castor oil. The irrigations should be given daily, and the local applications used at intervals of three or four days. Daily retained enemas of one or two ounces of olive oil are also soothing.

Foreign Bodies

Foreign bodies may lodge in the rectum after being swallowed, or may be inserted directly through the anus. Occasionally they may migrate from adjacent organs, or may form within the intestinal tract, such as gallstones or fecoliths. Foreign bodies may penetrate and lodge in the rectum as the result of an accident, but by far the greater majority are inserted deliberately, either out of curiosity, by perverts, or to relieve certain local conditions. The history

is difficult to obtain because of the reluctance of the patient to admit such acts on her part, or the patient is unaware of having swallowed anything which might produce such trouble.

Some foreign bodies are expelled spontaneously, some are easily removed, but others may require considerable ingenuity and skill to remove without serious damage to the rectal wall. The ingestion of large quantities of soft bulky foods or agar agar, followed by a laxative, may assist in expelling small objects.

Nonmalignant Growths

The most common forms of anorectal benign tumors are polyps and condylomas. **Polyps** may be single or multiple. The term refers to a pedunculated growth, but does not designate the type of cell. Polyps are usually benign in origin, but may undergo malignant change. The most common type of polyp is the adenoma, which usually originates from an inflammatory hyperplasia of the glandular elements of the mucosa. Such growths occur more commonly in children.

The most common symptom is bleeding at stool. There may also be constipation, straining at stool, a feeling of incomplete evacuation, and occasionally, the tumor may protrude through the anus. These growths can usually be felt by the examining finger, and proctoscopic examination will show the exact location, size, and number of the tumors.

Treatment consists of crushing the pedicle at its base and snipping the tumor off with scissors, without anesthesia, or the pedicle may be ligated and the tumor permitted to slough off. When there is an elongated base, a wide excision can be made, followed by electric coagulation of the site of removal. In multiple polyposis, treatment consists in the removal of any irritating process, and accessible tumors are snared through the proctoscope.

Condylomas.—These growths are also known as venereal or anal warts, papillomas, and verucca, but are not venereal in origin. They are caused by irritating discharges, and produce a tumorlike growth which surrounds the anus and has a cauliflower appearance. They are soft and bleed easily. Treatment consists in removing the cause of the discharge and cutting away small growths under local anesthesia, or removal of large growths under general anesthesia with the cautery.

Cancer

Cancer of the rectum and sigmoid occurs about as frequently as cancer of the uterus, and next to the stomach, they are the most common locations for all intestinal growths. Carcinoma occurs more frequently after middle life.

Etiology.—Cancer of the rectum bears the same relation to that organ as cancer bears to other parts of the body. There are found here the many predisposing factors and precancerous conditions that are found elsewhere; and many thoeries have been advanced to explain the etiology, but the specific cause is still unknown.

Symptoms.—External growths manifest themselves early to the patient, but in internal cancers the early symptoms are vague, with no tumor or local change visible to the patient. The earliest symptoms are some slight changes

from the regular action of the bowels, associated with tenesmus and uncomfortable sensations. The symptoms gradually increase, the bowel movement becomes "unsatisfactory," and the patient has a more or less constant desire to have a movement. The passing of blood and pus are usually late symptoms, as are also marked loss of weight and cachexia, as the growth in this part of the alimentary canal does not interfere in the assimilation of nourishment. Pain is an important symptom in epithelioma of the anus, but it is seldom pronounced in rectal carcinoma, unless the growth is very low or involves the sacral or pelvic nerves.

Diagnosis.—As the symptoms are not characteristic of carcinoma alone, the patient should have a thorough examination. Failure to make a diagnosis may be due to omitting the rectal examination or to an incomplete examination, the investigation stopping when some coexisting condition is found; or to failure to do a proctoscopy in cases where the tumor is beyond the reach of the examining finger. In late cases rectal cancer can usually be felt with the index finger, possibly as a protuberant mass superficially ulcerated, or as a craterlike excavated growth with an indurated base, or as an annular constriction with nodular or ulcerated surface, occurring especially at the rectosigmoidal junction. In doubtful cases proctoscopy should always be done as a supplement to digital examination, as it will reveal tumors beyond the reach of the finger. X-ray examination is unnecessary for tumors of the rectum and lower sigmoid, but is of great help in detecting lesions higher up.

Treatment.—The treatment of cancer of the rectum requires radical measures, which need not be detailed here.

INVASION OF THE PERITONEAL CAVITY

For the Treatment of Gynecologic Diseases

In the treatment of certain gynecologic affections it is necessary to invade the peritoneal cavity. This invasion of the great peritoneal sac in the center of the body necessarily carries with it much risk to the patient. In the preantiseptic days the mortality was great—so great that the operation was but rarely resorted to. By modern antiseptic and aseptic methods, however, the mortality has been reduced to a very small percentage. Though the mortality of the operation is small, we must not forget that there is a mortality due directly to the operation. The danger varies much in different cases, depending on the particular form of disease present and on the condition of the patient at the time of operation—but there is some danger in every case. Attention must be called to this because some physicians seem prone to overlook, or at least fail to give proper weight to the fact that occasionally a patient, with everything apparently favorable, will die, and no one can promise any patient absolutely that she will survive. One may say, in a favorable case, that the risk is very slight and that in all probability the patient will go through the operation and convalescence without trouble. But though the risk is slight, it is nevertheless a risk, which the patient must assume when she finally decides to have the advised operation.

In advising operation, the surgeon advises what he feels is best and safest for the patient after careful consideration of the various factors. He must consider not only the risk of operation but also the risk of waiting, which in certain cases means additional complications and increased danger. If this point is made clear to the patient, it aids her in a difficult decision.

The peritoneal cavity may be entered in two ways—by abdominal section (incision through the abdominal wall) or by vaginal section (incision through the vaginal wall).

ABDOMINAL SECTION

Abdominal section is incision into the peritoneal cavity through the abdominal wall. This is known as "celiotomy," "laparotomy," and "suprapubic section." All these terms refer simply to the incision through the abdominal wall into the peritoneal cavity and not to the subsequent operative manipulations carried out within the cavity.

The incision may be located at any part of the wall—in the median line or laterally. The direction of the incision may be longitudinal or transverse or oblique, or a combination of these directions.

There is usually some additional operative procedure carried out after the peritoneal cavity is opened, and this additional procedure frequently gives the name to the whole operation—for example, ovariotomy (abdominal section

with removal of an ovary or an ovarian tumor), myomectomy (abdominal section with removal of a myoma of the uterus), abdominal hysterectomy (abdominal section with removal of the uterus).

Indications and Contraindications

Abdominal operation is employed to take care of serious and disabling conditions which cannot be handled by less dangerous methods of treatment.

The more common contraindications to operation are marked nephritis (especially interstitial nephritis), diabetes, inoperable cancer, and advanced pulmonary tuberculosis.

Any chronic disease, general or local, causing marked weakness and lessening the patient's resistance, may contraindicate operation in a particular case. Also, acute diseases that might be aggravated by the operation, any condition that would contraindicate general anesthesia (if such is to be used), or dermatitis at the site of operation.

All these contraindications are, of course, only relative. There may arise circumstances demanding the operation at once in spite of contraindications —that is, circumstances in which the danger of delay would be greater than the danger of immediate operation. But when the case is not one of extreme urgency, the operation should be postponed until the complicating condition can be corrected and the patient placed in better condition.

Pregnancy increases the danger of abdominal section very decidedly, but it is not often a contraindication for the reason that the disease requiring operation (for example, a large tumor or an abscess) precludes the full development of the fetus or makes the dangers from advancing pregnancy greater than those from immediate operation.

Dangers

The immediate dangers of an abdominal section are three:

1. Failure of the vital forces to stand the shock of the operation. This shock is due principally to (a) the loss of blood, (b) the handling of intraperitoneal structures, and (c) the anesthesia.

2. Failure of the vital organs (heart, lungs, kidneys, and gastrointestinal tract) to perform the extra work thrown on them in the first few days following the operation.

3. The development of infection, causing general peritonitis or localized suppuration.

PREPARATIONS

For Abdominal Section

In order to reduce to a minimum the dangers of the operation, careful preparation is required.

The various items of preparation may be conveniently grouped under three headings, which will be considered in the following order:

    A. Preparation of the patient.
    B. Preparation of instruments and dressings.
    C. Preparation of operator and assistants.

A. Preparation of the Patient

The patient, having been subjected to a careful general examination, including urine analysis, to exclude contraindications, is sent to the hospital one or two days before operation, that the proper preparation may be carried out. Of course there are cases of rapidly spreading pelvic inflammation, or of intraabdominal hemorrhage or injury, in which the abdomen must be opened at the earliest possible moment. In such a case there is no time for preliminary preparation—careful immediate sterilization is carried out and the abdomen is then opened. But when the case is not an emergency one, the preliminary preparation should be made. It gives the patient a decidedly better chance of complete and uninterrupted recovery.

Medication.—Sleep is important, and it is well to have a regular order for sodium bromide or other sedative, to be given as needed to quiet the nervous system and avoid wakefulness.

A preanesthetic sedative eliminates the anxiety of the trip to the operating room and starting the anesthesia, and also reduces the amount of anesthetic required. For this purpose, morphine sulphate, ¼ gr., and atropine sulphate, ¹⁄₁₅₀ gr., given about forty-five minutes before operation, are used by many. For some years the authors have been using hyoscine-morphia analgesia as a preanesthetic sedative, and with much satisfaction. Morphia sulphate, ¼ gr., and hyoscine hydrobromide, about ¹⁄₁₃₀ gr. (one ampule—B & W), are given hypodermically one hour and forty-five minutes before the operation. The hyoscine (but *not* the morphia) is repeated forty-five minutes later, i.e., one hour before operation. The patient is then kept quiet with the room darkened until taken to the operating room.

The hyoscine-morphia analgesia eliminates the preoperation anxiety, which is so troublesome to some patients and more or less troublesome to all. As a rule, the patient knows nothing about the trip to the operating room and the induction of anesthesia and is surprised when she learns that the operation is over. Also, the patients take the anesthetic more quietly and require less for operations of the same length. Again, there is less postoperative vomiting and distress. The dose of the drugs should of course be adjusted to the size and condition of the patient, being somewhat less than the above for small or weak individuals.

When spinal anesthesia is to be employed the following preanesthetic sedation is preferred: ten grains of sodium barbital are given by mouth one and one-half hours before the operation.

Hypodermic injection of pantopon, one-third of a grain, with scopolamine, one one hundred and fiftieth of a grain, is given one hour before the operation. The patient's ears are stopped up with cotton, the eyes covered and the room kept quiet.

Light diet is to be given up to and including noon of the day before operation, then liquids only, but with water in abundance. After midnight, just preceding operation, nothing is to be given by mouth but water, and the water may be continued to within an hour of the operation.

An enema is to be given the night before, and again the next morning. The idea is to have the intestinal tract in as nearly normal condition as possible, with just a good clearing out of the lower bowel just before the operation. Experience has shown that this simple method of preparation brings the patient to the operating table in better condition and causes less disturbance after the operation than the prolonged dieting and purging formerly employed.

In cases of marked habitual constipation and cases in which the bowels are not to be moved for some time after operation, such as in repair of complete laceration into the rectum, it is well to clear out the intestines some days before, but avoid prolonging increased peristalsis to the operation. When there are complications that may necessitate resection of the intestine or opening of the stomach, then, of course, the usual preoperative measures for approximate sterilization of the upper intestinal tract would be indicated.

Preliminary Sterilization of the Field.—In the preparation of the operative field, as in the intestinal preparation, the trend of practice has been toward simplicity. It has been found that some of the measures formerly employed served to irritate the skin and increased rather than diminished the chance of inflammation. This was true particularly of the strong antiseptics applied for long periods preceding operation. Instead of the extensive soap poultice and the prolonged antiseptic pack, the following method, with minor modifications, is now employed generally:

The afternoon before operation the abdomen is lathered and shaved. It is then scrubbed with green soap and, after soap is removed, with sterile water, and then the surface is washed with alcohol. The cleansed surface is covered with a sterile towel or sterile cotton, held in place with a binder.

In most of the gynecological cases vaginal preparation also is needed, because part of the operation is vaginal or the vagina is to be opened into or conditions may be found requiring it to be opened. On this account, preoperative vaginal preparation along with the abdominal is made routinely, unless otherwise ordered in some exceptional case.

In the *preliminary vaginal preparation*, the pubic region, vulva, and perineum are shaved, and a douche is given. Then 8 c.c. of 1 per cent solution of neutral acriflavine in glycerin ("A-G" solution) is injected into the vagina, and a sterile perineal pad applied. Next morning, after the enema has been expelled, another vaginal injection of the acriflavine solution is made and the pad applied.

Catheterization.—A convenient time and place for the catheterization is during the preparation in the operating room immediately preceding operation —during the vaginal preparation if made; otherwise just before the abdominal preparation. Catheterization at that time has the added advantages of emptying the bladder immediately before operation (instead of an hour before, after which a troublesome amount of urine may collect in some cases) and of avoiding disturbance of the patient while hyoscine sleep is being induced.

Preparation in Operating Room.—The final sterilization of the abdominal field is ordinarily carried out as the patient is being anesthetized, though exceptionally it may be advisable to complete this preparation before the anesthesia is begun in order to save time under the anesthetic. As previously explained, vaginal preparation also is advisable in most abdominal cases, and this is usually completed just preceding the abdominal preparation. If the patient is in good hyoscine-morphine sleep, no additional anesthesia is needed for the vaginal preparation, which may be immediately proceeded with.

The patient's hips are drawn to the edge of the table and the feet are supported out of the way by stirrups. The external genitals and vicinity all round are cleansed thoroughly with green soap and warm water, using gauze or cotton balls, rinsed with sterile water, and then with bichloride or cyanide solution.

Catheterization is now carried out with strict asepsis, the labia being held away and the meatus specially cleansed. The sterile catheter should be lubricated and care should be taken to avoid contaminating the bladder portion with soap or irritating antiseptics.

The vagina is then cleansed with green soap and warm water, rinsed with sterile water, and then with bichloride or cyanide solution, using small pieces of gauze or cotton and opening the vagina with a speculum. If the opening is too small for the speculum, a finger may be used beside the sponge forceps. The details of vaginal preparation are explained later under Vaginal Section.

If the operation is to be complete abdominal hysterectomy, some iodine solution is applied to the vaginal vault, and removed with alcohol. If the hysterectomy is for a condition accompanied with infective uterine discharge, the cervix is grasped with a tenaculum forceps and the uterine cavity is packed with a quarter-inch gauze drain moistened with iodine solution.

When the vaginal preparation is finished, the patient is drawn back to the proper place on the table, the leg supports are removed, and the abdominal field is prepared. In arranging the patient on the table for the abdominal preparation and operation, watch that the knees are just at the joint of the table top, so that they will bend with the joint when the feet are lowered slightly in the later Trendelenburg position. When the patient is in position and the arms and hands are arranged safely (Fig. 1103), the abdominal surface is painted with the iodine solution over the large area shown in Fig. 1104.
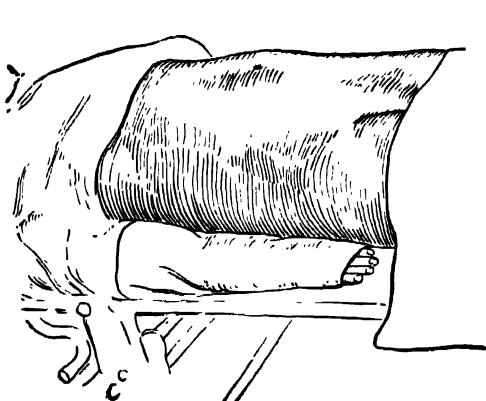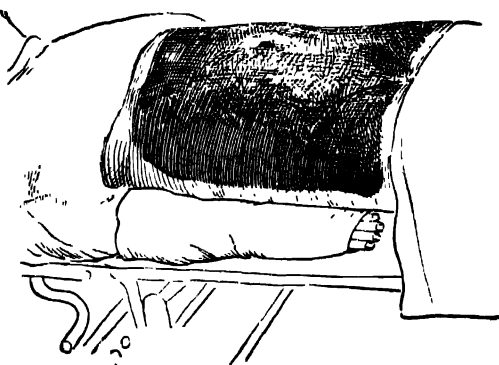
Fig. 1103.   Fig. 1104.

Fig. 1103.—Another safe position of the arms during anesthesia, and the preferable one for abdominal operation. This effective arm protection is secured by the use of the special arm restraint. When ready to restrain the arms, the upper flap is raised out of the way and the lower flap is brought up over the arm and tucked under the patient, taking care to smooth it out so that it goes well above the elbow and also down to the middle of the fingers. Then the upper flap is brought down over the arm and tucked securely under the patient. The hand should lie flat on the table, as indicated by the fingers in the illustration.

If there should be some loosening during anesthesia, the upper flap is again pushed well under the patient when relaxation is attained.

This illustration shows also a step in the operating room preparation of the operative field. The vaginal preparation (which is advisable in most cases of abdominal operation for pelvic disease) has already been made, the patient has been pulled up on the table to the position for abdominal operation, the leg supports used in the vaginal preparation have been removed, and the abdominal surface is exposed preparatory to painting it with tincture of iodine (7½ per cent).

Fig. 1104.—Preparation of operative field. The abdominal surface painted with tincture of iodine, which will be immediately removed with alcohol. (Crossen—*Gynecology for Nurses.*)

Particular care should be taken to sterilize the depth of the umbilical depression, to rub in the solution along the line of incision, and to extend the sterilization down over the pubes well beyond the lower end of the incision (Fig. 1104). Iodine is a skin irritant and must be removed with alcohol. Consequently, particular care should be exercised in applying it, that none be allowed to run down where it will escape removal; e.g., to the patient's back or in the genital creases between the thighs. Also, in the removal with alcohol, be sure that no iodine is left around the edges or elsewhere. Some patients have an idiosyncrasy to iodine and any left on the skin causes dermatitis, particularly under the adhesive strips. In this preparation, it is well to use forceps for holding the gauze pieces, as this eliminates contact with gloves and gown sleeves.

In applying the iodine to the abdominal surface and in removing it, special care must be exercised to avoid contaminating the median sterilized area from the unsterilized sides. Keep in mind that the incision is to extend down to the pubic area, and consequently there must be no movement of the gauze swab across this site from the lateral edges of the field.

To avoid such contamination it is necessary to follow a definite plan of procedure with two points in view; namely, (a) no movement of the swab from an unsterilized to a

sterilized area and (b) no movement of the swab from the pubic area (with its numerous hair follicles and greater bacterial content) up over the abdominal surface. At first thought it may seem that this could be easily accomplished by simply making all movements outward from the incisional area. But this is time-consuming, and unless the swab is discarded at the end of each stroke material is carried from the far lateral areas to the center. The following plan is effective, easily followed and may be carried out rapidly (a point of importance in saving time under anesthesia).

The first step is thorough application to the depth of the umbilicus, with discarding of that swab. Then by circular motion, enlarging from the umbilicus, the central area is sterilized down to near the pubic area, as shown in Fig. 1105, one or two swabs being used as needed. In the second step, with downward and outward strokes application is made to the pubic area and adjacent thigh surfaces (Fig. 1106), changing swabs as necessary to avoid recontamination of sterilized surfaces. Then, in the third step, with a fresh swab or two application is made to the outward portions of the abdominal field (Fig. 1107), giving the complete coverage indicated in Fig. 1104. The same plan is followed in the rapid removal of the iodine with alcohol swabs. A final firm wipe is made from the umbilicus down the median line and over the pubes.

Fig. 1105.　　　　　　　Fig. 1106.　　　　　　　Fig. 1107.

Figs. 1105 to 1107.—Sterilization of operative field. These illustrations are employed to emphasize the necessity of care and systematic procedure in this important feature of preparation for operation. As explained in the text, in order to avoid recontamination of partially prepared surfaces, the sterilization proceeds by three distinct steps.

Fig. 1105.—Completing the first step. Fig. 1106. The second step. Fig. 1107. Starting the third step, which when finished gives the complete coverage shown in Fig. 1104. (Crossen and Crossen—*Operative Gynecology.*)

When the sterilization of the operative field has been completed, the area is draped with the sterile coverings, the patient's hips are elevated to the Trendelenburg position, and the small platforms for the operator and assistants to stand on are slipped into place (Fig. 1108).

When preparing to place the Mayo table over the patient, the leg-rest is dropped slightly and then the table is slipped into place. This lowering of the feet in the Trendelenburg position should be very slight, only enough to level them out of the way of the Mayo table. Any considerable dropping of the feet and legs increases the tension of the abdominal wall, and is to be avoided.

The sponge bag is clamped to the laparotomy sheet at a convenient place as indicated in Fig. 1108, in order to facilitate pulling the strip-sponge out of the containing bag and placing the soiled portions in the receiving compartment. The sponge-end of the bag should be at the *pubic end* of the incision so that the sponge passes to and from the pelvic cavity *always over the pubic area,* which is free of forceps.

In the operating room after anesthesia, all preparations should be carried out *rapidly*. Every minute's prolongation of the preparation takes time which may be urgently needed at the critical stage of the intra-abdominal work. This is a very important point, and it should be repeatedly impressed on assistant physicians and nurses. Every preparation should be carried out as rapidly as accuracy will permit. The saving of seconds and minutes under anesthesia is much facilitated by good teamwork among those engaged in the preparation of patients. The repeated emphasis of this point by the chief assistant physician and by the nurse supervisors will create an *esprit de corps* that makes for rapid accurate work—to the benefit of every patient handled and to the added satisfaction of all concerned.

Fig. 1108.—Preparation of operative field. The patient has been elevated into the Trendelenburg position and the continuous-strip sponge bag has been clamped in place. The small platforms for the operator and assistants to stand on have been pushed into position.

The gauze-strip sponge bag is in position. Notice that the sponge-end of the bag is at the *pubic end* of the operative field, so that the sponge will be carried into and out of the pelvis over the pubic area which is free of forceps. (Crossen—*Gynecology for Nurses*.)

B. Preparation of Dressings and Instruments

The dressings, pads, towels, sheets, gowns, instrument trays, and basins are all put through the steam sterilizer, and kept wrapped ready for use. Attention may be called to certain special points in the preparation and arrangement of the sponges and instruments.

Sponges.—In regard to the form of sponges to be used, the authors strongly recommend the **continuous gauze-strip sponges** for abdominal work. The numerous detached sponges ordinarily used are dangerous and have led to many serious results. A sponge left in the peritoneal cavity following an operation constitutes one of the most deplorable accidents of abdominal surgery. This is not a new subject. Much has been written upon it and many cases have been reported, and many suggestions have been made as to preventive measures. But all such measures hitherto proposed have broken down under the various circumstances and vicissitudes of surgical work, as evidenced by the facts cited in an extensive monograph by the senior author. In this connection attention must be called to the following facts:

a. Sponges are lost in the peritoneal cavity much more frequently than is generally supposed. And it must be kept in mind that the reported cases represent only a small proportion of the recognized cases, for, naturally, the accident is not given publicity except where there is some special reason for doing so. In any large body of surgeons, a little experience meeting, in which testimonies are freely given, will bring to light a number of unreported cases of this accident.

Furthermore, many cases are not even recognized. The patient dies with evidence of peritonitis; there is no suspicion of any foreign body having been left in the abdomen, no postmortem examination is made, and the death is supposed to be due to ordinary peritonitis. The possibilities in this direction are indicated by the fact that in a reported series, in thirty-nine of the cases the accident was recognized only on postmortem examination, when the sponge was found, but would have remained unknown had there been no autopsy.

b. It is a most serious accident. In the large series of cases collected, more than one-fourth of the patients died, and of those who recovered many went through weeks and months of suffering.

c. To persons outside the profession the accident seems absolutely inexcusable. They can understand how other complications may arise, such as hemorrhage or sepsis or kidney failure, in spite of every precaution, but they can imagine no reasonable excuse for allowing a sponge to be lost in the patient's interior. To those not familiar with surgical work it seems past belief that the surgeon would carry into the peritoneal cavity anything the removal of which was not provided for with absolute certainty.

The growing cognizance of the public in regard to the occurrence of this accident and the feeling in regard to the responsibility for it are reflected in the increasing number of lawsuits connected therewith.

d. There has hitherto been no sure preventive method which was applicable in all the circumstances of abdominal surgery. The list of preventive measures recorded shows that much thought has been given to devising means for preventing this accident. Rules interminable have been proposed, and expensive and cumbersome racks and stands devised for the purpose. Not one of these devices, however, has proved absolutely safe, for the reason that in their use the certain removal of all sponges carried into the abdomen depends on the studied attention of the operator or on a system of attentive cooperation among assistants and nurses. While such attentive cooperation is entirely feasible under ideal conditions and with ideal persons, the fact remains that it is not secured and is not likely to be secured under the variable circumstances of abdominal work. The many emergencies which arise in the course of abdominal operations, the changing of assistants and nurses, the hurried operations at night in the hospital with insufficient help, the operations in private homes where the patient cannot be taken to the hospital at all—all these conditions play havoc with safety arrangements depending upon a nicely balanced system of rules and cooperation or on the use of cumbersome racks or stands.

There is not space here to take up in detail the various ways in which mistakes have occurred; suffice it to say that a review of the cases where dependence was placed on counting shows an appalling list in which a sponge was left, because one was hastily torn in two and one-half forgotten, or an extra one was primarily included in the bundle and missed in the counting, or an extra one was secured for an emergency during the operation, or some loose piece of gauze, not intended for intraperitoneal use, slipped in while near the wound, or a mistake was made in the final count of the sponges removed. It is astonishing what slight inattention may lead to a sponge being left, and the consequent death of the patient.

The method of attaching a tape to each sponge and then fastening a forceps to the tape and at the same time to the abdominal sheet is the method probably in most general use. It has a record of many accidents—the tape pulled off the sponge, or there was a failure to attach the forceps, or the forceps failed to hold well. In one case recorded the sponge, tape and forceps were all lost in the cavity.

The difficulty of guarding absolutely against leaving a sponge in the abdomen is such that entire security against this fatal accident is counted one of the unsolved problems of abdominal work. Practically all writers on the subject state that there is no guaranty against its occurrence, even in routine hospital work and with all the rules of cooperation and the special apparatus designed to prevent it. Neugebauer, in a most exhaustive consideration of the subject, comes to the conclusion that the accident is, to a certain extent, unavoidable. Schachner, in an excellent paper, states, "So long as surgery continues an art, just so long will foreign bodies continue to be unintentionally left in the abdominal cavity." Findley states, "In former years the abdominal surgeon was seriously disturbed by well-grounded fears of secondary hemorrhage and sepsis, but surgery has mastered these problems to a large degree and they are little feared and seldom experienced. Now it is the thoughts of the sponge that disturb the night's repose when the report comes that something has gone wrong with our patient. The operator never can rid himself of the feeling of uncertainty as to the possibility of leaving a sponge." This expresses very well the feeling of those who have given attention to this subject, and particularly of those who have personally experienced the accident and have thus been brought face to face with a concrete exemplification of the inadequacy of the usual methods.

The continued occurrence of this fatal accident and the failure of the preventive methods in general use constitute sufficient reason for emphasizing a method which the authors have used with much satisfaction for many years. This method gives entire security and at the same time is simple and inexpensive, and is effective in all conditions of abdominal work—in the emergency operation in the country with unfamiliar assistants, as well as in the routine hospital work. The failure of the safety methods in general use is due to their dependence upon sustained attention concerning the sponges, which attention on the part of the surgeon cannot be given to the sponges, for it is required elsewhere. A method, to be effective under all circumstances, must be practically automatic, insuring the removal of all gauze without particular attention on the part of any one at the time of the operation.

THE METHOD

The underlying principle of this method is the elimination of all detached pads and sponges. In place of them long strips of gauze are used, each strip being packed into a bag in such a way that it may be drawn out a little at a time as needed.

The senior author was led to a study of the subject and the adoption of this method by an unfortunate experience. Following the usual technique he operated for years without accident, and then one day he left a gauze pad in the abdomen. The case was one of diffuse

pelvic suppuration, requiring extensive drainage, and, fortunately, the pad was discovered and extracted through the drainage opening about two weeks later. The patient recovered without serious result from the accident—but the lesson was not lost. He determined to find some method that would really prevent such an accident—a method which would be entirely under the control of the operator and first assistant (a greater division of responsibility increases the danger), and one which would occasion no delay in the closing steps of the operation.

In persuance of this idea the method described in the illustrations was devised. The object of the method is to make the removal of all sponges automatic, and therefore independent of sponge counting and other uncertain procedures. The essential feature of this method is the substitution of a long gauze strip for the ordinary detached sponges, the greater part of the strip being always outside the abdominal cavity. The strip is ten yards
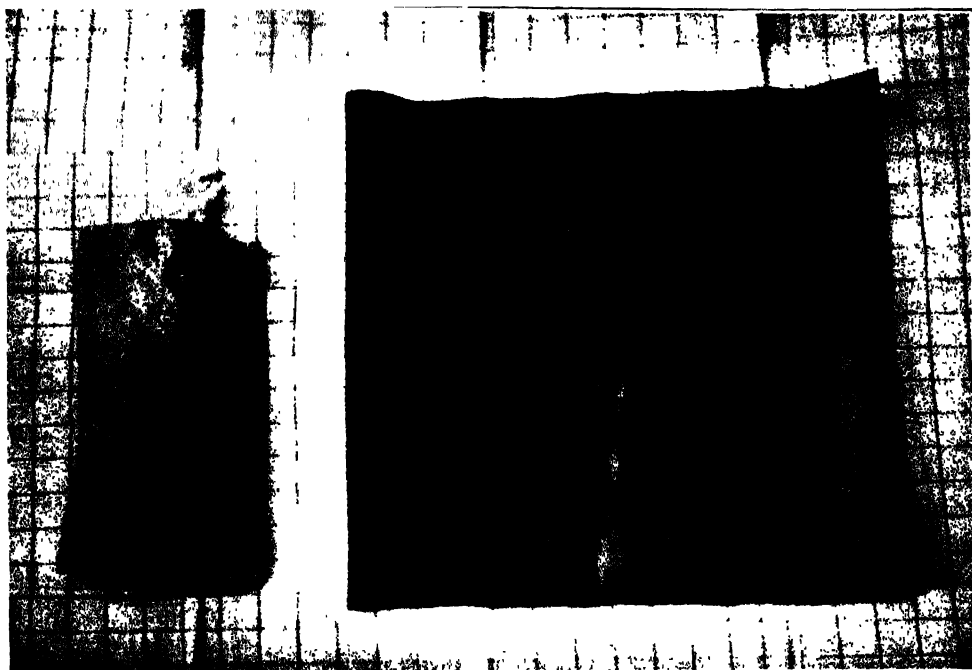
A.   B.

Fig. 1109.—Articles for abdominal sponging and packing.
A, The filled bag, folded and ready to be wrapped for sterilization and storage. B, The heavy rubber sheeting for packing back the intestines. This is very heavy pure gum rubber dam No. 20 gauge, measuring 18 by 36 inches. The lighter weight rubber dam was found not satisfactory for this work. (Crossen and Crossen—Operative Gynecology.)

long. Two strips are made by dividing the yard-width of gauze in the center and folding each half longitudinally to six thicknesses. Each strip is therefore ten yards long, about three inches wide, and has six thicknesses of gauze. For protection and convenience in handling, the strip is packed into a small muslin bag, five inches wide and ten inches deep. The end of the strip is stitched near the top of the bag, and the strip is then packed into the bag in such a way that it may be pulled out a little at a time, as needed. The filled bags are sterilized and are then ready for use (Fig. 1109, A). At operation, the bottom of the bag is clamped or pinned to the abdominal sheet, and the gauze strip is pulled out a little at a time as needed for sponging. For packing back the intestines, sheet rubber is used. Experimentation with different sizes and weights resulted in the adoption for routine use of a piece 18 by 36 inches of very heavy pure gum rubber sheeting, No. 20 gauge (Fig. 1109, B). This may be folded as desired.

The arrangements for abdominal packing and sponging thus become very simple (Fig. 1109). The intestines are packed away from the field with the rubber sheeting and the sponging is done with the continuous-strip sponge.

This method eliminates all chance of leaving a piece of gauze in the abdomen, for a large part of the strip is always outside the cavity, and the end is fastened securely outside. An important point is that the sure removal of all gauze is practically automatic. It does not depend on the accuracy of a hurried counting of sponges at the close of the operation or catching each spongetape with a forceps as it is put into the cavity, or on a studied "watching what sponges go in and what sponges come out of the cavity." Those methods that depend for safety on the observance of complicated rules or on the strict following of a regular routine, or on the constant attention of the operator, have all broken down, as reported cases clearly show. A method, to be safe and suitable for general use, must be practically automatic in the removal of all gauze carried into the cavity, must be comparatively inexpensive in materials and preparations, must be fairly simple and convenient in use, and must be applicable in every environment, including emergency work in the country. These requirements are met by the method here described.

The dangers from hemorrhage and sepsis in clean cases have been largely done away with through improvements in technique, and now this other serious menace in abdominal work should be eliminated. The patient has a right to demand, and is demanding as the many lawsuits show, that real protection be afforded against leaving a sponge in the abdomen. It seems only justice to those who intrust themselves to our care that we should provide absolute security against this fatal accident, so far as such security is practically attainable.

This method also simplifies the preparations for abdominal section—all the many pads and sponges of various sizes being replaced by two strips of gauze. The gauze is simply folded and then tacked by a few stitches at each end to prevent unfolding. Nurses as a rule welcome the method, stating that it is much less troublesome than the sewing of the numerous small pads and sponges. The bags may be used again and again after sterilization.

LONG INSTRUMENTS

In about one-fourth of the recorded cases of a foreign body left in the abdomen, the article left was a forceps or piece of an instrument or other small object used about the wound. This calls attention forcibly to the fact that small instruments should not be allowed about an open abdominal wound. Neugebauer long ago called attention to this danger of small instruments, and urged the use of long instruments exclusively in abdominal work.

Many surgeons have adopted this safety measure, but there are many others who seem to give no thought to the matter, and continue to use numerous small instruments in this dangerous locality. It may not be possible at present to prevent entirely the accident of leaving some article of the surgical armamentarium in the abdomen, but it is possible to reduce the danger to a minimum by the use of long instruments exclusively, and it seems to me that all those who are engaged in abdominal surgery should be led by common prudence to adopt this simple expedient. The details, as carried out in the authors' work, are as follows: Every instrument used about the wound is long—so long that a portion of it is practically always outside the abdominal cavity. Again, if by accident such an instrument should slip entirely into the cavity, its length is such that it would almost certainly be felt when the hand is carried into the cavity for the final palpation before closing. All the artery forceps, dissecting forceps, tenaculum forceps, pedicle needles, scissors, and other instruments for internal work are from six and one-half to eight inches long, the shortest being the large dissecting scissors (six and one-half inches). The shortest instrument used anywhere about the wound is the scalpel (six inches), which is laid aside as soon as the

peritoneal cavity is open. The needles and Murphy buttons are not brought near the wound, except when held with a forceps or with a suture attached. No Michel clamps (for holding rubber tissue or gauze along the wound margin) or other small unattached objects are allowed near the wound as long as the peritoneal cavity is open.

It is not necessary to take space for instrument lists for various operations or the details of their sterilization and arrangement. The operating-room nurses have their complete lists and directions covering these items, which belong to nursing and may be found in detail in the books on the subject, for example, the authors' *Gynecology for Nurses*.

Suture Materials.—Many different types and sizes of catgut are used by different operators in pelvic abdominal work. To simplify matters the authors have adopted three kinds for routine use. For ligating and suturing specially heavy pedicles, No. 1, forty-day catgut is used. This long-lasting catgut answers the purpose where a strong, lasting approximation is necessary, as in fastening the broad ligament pedicles to the vaginal vault in complete hysterectomy. For ordinary pedicle ligation and approximation, we prefer catgut that is more quickly absorbed, such as the twenty-day catgut. The terms "forty-day" and "twenty-day" refer to the lasting period in connective tissue, but the lasting period is very much less on peritoneal surfaces and especially on mucous surfaces.

The plain catgut is used, in slender intestinal needles, for suturing in conservative work on the ovaries and tubes and for suture-ligation of the mesoappendix and other small delicate pedicles. It is used for tying the stump of the appendix, preceding the silk or linen inverting suture, and also for the closing skin suture.

The twenty-day catgut is used for all the layers of the abdominal wall except the skin, and for inside ligating generally.

ARRANGEMENT OF SUTURES AND LIGATURES

The progress of an operation is much facilitated if all the sutures likely to be used are threaded and ready before the incision is made. In preparing for the ordinary abdominal operation for pelvic disease, it is well to have needles threaded as follows:

Four Mayo needles, each threaded with half a strand of No. 1, twenty-day chromic catgut. It is well to tie the end of each suture in the needle by a half knot. Chromic catgut is stiff and should be softened by being soaked for a minute in water or by being drawn once or twice through wet gauze.

These sutures are for pedicles and inside work generally. If the operation involves a hysterectomy or the removal of a tumor, two additional Mayo needles should be threaded, making six in all. The tube of forty-day catgut is for any special work for which the operator may need such a long-lasting catgut.

One slender curved intestinal needle threaded with a twelve-inch suture of fine silk *(D)*, or linen if preferred, with end tied in the needle by a half knot. This is for the inverting suture about the appendix stump, and for suturing any intestinal injury.

Two large full-curved cutting needles, each threaded with half a strand of No. 1, twenty-day catgut, with end tied in needle. These are for closing the abdominal incision, and are used in suturing the peritoneum, muscles, and aponeurosis.

Six large full-curved needles, each threaded with a heavy strand of silkworm-gut. These are not tied in the needle, but are fastened by twisting. Pull about one-fourth of the suture through the needle and then twist with three full turns—no more and no less,

This usually fastens the suture so it will stay in the needle while being passed and yet it will come out easily when pulled on. These silkworm-gut sutures are used as stay-sutures, and the heavy strands should be selected. They are placed just before the suturing of the aponeurotic layer of the wall.

One long straight trocar-point needle, threaded with half a strand of No. 00 plain catgut with end tied into needle with a half knot. This is for suturing the skin.

It is advisable to arrange the threaded needles so that they will not get lost or tangled. When the sutures must be prepared hurriedly by the nurse or assistant physician, it is well to place the strong suture-ligatures (twenty-day catgut in Mayo needles) directly in the needle holders for immediate use. The appendix sutures (plain catgut and fine silk, each in slender curved needle) may be clamped in a curved forceps until needed, and the sutures for the abdominal wall are stuck in a towel in the order in which they will be needed.

C. Preparation of Operator and Assistants

Everything that is to come in contact with the operative field must be sterilized. The hands and forearms of the operator and assistants must be disinfected as far as possible, and should then be covered, so that there is no chance of direct contact of the operative field with the skin of the hands or arms, for the skin cannot be absolutely sterilized. Again, the operator and assistants must be so covered as to effectually protect the field of operation from contamination by particles from the hair or beard, or by particles carried in the breath.

The accomplishment of this thorough protection of the operative wound has been the object of many decades of study and experimentation. The present effective technique for the preparation of the operator, as well as all the other antiseptic and aseptic preparations, was attained gradually, by improvements added year by year, but it is all the direct outgrowth of the epoch-making work of Pasteur and of Lister. The following are the steps in the preparation of the operator and assistants:

1. The sleeves are rolled well up above the elbows and the finger nails are trimmed short and cleaned thoroughly.

2. The hands and forearms are then scrubbed carefully and vigorously, for ten to fifteen minutes, with warm water and some liquid preparation of green soap—using a stiff brush and giving particular attention to the irregularities about the nails and knuckles and to the spaces between the fingers at their junction with the hand. Where the brush causes undue irritation of the skin, gauze is preferable for scrubbing the arms, but a brush should be used on the hands.

3. Then the soap is washed off with sterile water, and the hands and forearms are scrubbed in 80 per cent alcohol with gauze.

4. Then they are scrubbed in bichloride solution (1:2,000), with gauze.

5. The long-sleeved sterile gown is then put on, and the cap and face mask are applied. As the rubber gloves are put on, the gauntlet of the glove is brought up over the lower end of the sterile sleeve to hold it in place. The arm is thus securely covered and there is no chance for any skin surface to come in contact with the wound. The assistants go through the same process.

The process of hand-disinfection just given is known as the "alcohol-bichloride" method. It is called also, from its originator, the Fürbringer method.

The careful and prolonged scrubbing with soap is the most important feature in any method of hand-disinfection. This fact has long been recognized,

and many operators have discarded bichloride and other irritant antiseptics and depend entirely on the soap scrubbing followed by the scrubbing in alcohol. When carried out with care and judgment, this practice is safe and gives good results and avoids the irritation due to bichloride. In some persons, however, alcohol causes more irritation than bichloride.

There are *three methods of hand-disinfection* which are much used. The thorough scrubbing with green soap and warm water is common to all of them. The further steps differ as follows:

a. The "alcohol-bichloride" method. The various steps in this method have just been given in detail.

b. The "permanganate and oxalic acid" method. The hands and forearms are next immersed in a hot saturated solution of potassium permanganate and kept there until the skin takes on a dark brown color, then they are immersed in a hot saturated solution of oxalic acid until the skin again has its natural color. The oxalic acid is washed off in sterile water or sterile limewater.

c. The "chlorinated lime and sodium carbonate" method. After the preliminary scrubbing, a tablespoonful of chlorinated lime is taken in the palm of the hand and moistened with enough water to make a thick paste. Then a piece of sodium carbonate (washing soda) about the size of the thumb is crushed in the hand and rubbed thoroughly into the lime paste. This mixture, containing nascent chlorine, is rubbed vigorously into the skin of the hands and forearms for from three to five minutes. The parts are then washed in sterile water, and later in weak ammonia water to remove the chlorine odor.

As to the choice of method of hand-disinfection, that is largely a matter of personal preference. Any one of the above three methods, properly carried out, will give good practical hand-disinfection—i.e., from hands and arms so prepared, infection will rarely if ever take place. The important thing is not which method is chosen, but *how thoroughly* the chosen method is carried out.

Absolute disinfection of the hands and arms is impossible by any method, as the disinfection is necessarily confined to the superficial layers of the epidermis. Bacteria situated in the deeper layers of the epidermis may work to the surface during the course of the operation—hence the importance of thoroughly covering the prepared hands and arms with rubber gloves and sterile sleeves, leaving no skin surface exposed.

REGULAR STEPS

In Abdominal Section

In order to present some idea of the main features of this important therapeutic measure, the regular steps in this operation will be simply enumerated, and later some of the special points that require attention considered briefly.

The regular steps incident to every case of abdominal section are as follows:

1. Anesthesia.
2. Incision.
3. Exploration.
4. Correction of pathologic condition.
5. Toilet of peritoneum.
6. Closure of incision.
7. Dressing.

In abdominal section for pelvic disease the incision is made, almost invariably, in the median line. All parts of the pelvis may be reached from such an incision and, in practically every case, exploration of the whole pelvis should be made. Ordinarily the incision is begun near the umbilicus and continued downward from four to six inches. If there is no large solid tumor, the incision is made small at first, but large enough to admit the fingers or hand into the pelvis for exploration. As a rule, the primary incision is about five inches long. If the abdominal walls are very thin, it may be shorter; if they are very thick, it must be longer.

The lower the incision is placed, the more easily the deeper portions of the pelvic cavity may be reached. When a tumor is present, the bladder may be drawn up considerably; consequently in such a case the incision must not be extended low until the peritoneal cavity has been opened and the bladder located. If it is thought that the bladder may be drawn so high as to interfere with the ordinary incision, a steel bougie may be introduced into the bladder and the height of its cavity determined before the incision is made.

In cutting through the abdominal wall it is not necessary to strike the tendinous tissue between the recti muscles. If the incision is made a little to one side of the tendinous center and passes through the rectus muscle of that side, it makes little difference. Consequently, no time should be lost trying to make a careful dissection exactly in the median line.

The incision is continued through the skin and the subcutaneous fat and fascia, and the rectus muscle with its tendinous sheath, down to the loose subperitoneal fat. When the subperitoneal tissue is reached, all bleeding is stopped, and the subperitoneal fat and connective tissue are cut through between two dissecting forceps. The peritoneum is then picked up with the dissecting forceps and a short cut is made in it, and this opening in the peritoneal cavity is enlarged by scissors or knife.

Sterile towels now may be fastened on each side to the edges of the peritoneum to avoid any contact with exposed skin surface.

SPECIAL POINTS

In Abdominal Section

There are a number of special items that must receive careful consideration by every one doing abdominal section work. Among these may be mentioned the following:

1. Drainage.
2. Shock.
3. Injury to adjacent organs.
4. Foreign bodies in abdomen.

1. **Drainage.**—The rule in abdominal surgery is not to drain unless there is some special reason for it, and that special reason must be a very strong one. Experience has abundantly shown that in all but exceptional cases the best results are obtained by closing the peritoneal cavity completely and leaving Nature to carry on the reparative process alone, undisturbed by tubes or gauze or other form of drainage.

That small percentage of cases in which drainage is advisable includes the following classes:

a. Rapidly spreading inflammation of the peritoneum or acute general peritonitis. In such cases free drainage is indicated, and, as a rule, the freer the better.

b. Rupture of abscess in pelvis. This accident happens not infrequently during the enucleation of an inflammatory mass containing pus. In some cases the pus is not confined in any removable sac, but has burrowed in various directions among the adherent organs. In such a case as soon as the adhesions are separated, the pus flows out into the peritoneal cavity.

c. Persistent free oozing from surfaces left after the enucleation of an inflammatory mass. Here the effect desired is pressure rather than drainage, but, as the end of the gauze used for pressure must be brought out through the abdominal wound or through the vagina, it is usually referred to as a drain or pack.

2. **Shock.**—The principal factors in shock are (a) loss of blood, (b) exposure and handling of abdominal contents, and (c) long anesthesia. To avoid shock, therefore, particular attention must be given to the following points:

a. Careful hemostasis. All vessels that can be located are ligated or clamped before they are divided. In cutting through ligated tissues, forceps are in readiness to catch any vessel that may have escaped the ligature or upon which the ligature is not tight enough.

b. Protection of the abdominal contents, so far as possible, from handling and exposure. The Trendelenburg posture accomplishes this to a large extent. In this posture the intestines and omentum gravitate into the upper part of the abdominal cavity, away from the field of operation. Those parts that still tend to protrude into the pelvis are held out of the way by gauze or rubber dam, which, at the same time, serves to wall off the pelvis from the abdominal cavity. When the intestines are unavoidably permitted outside of the peritoneal cavity, they should be kept covered with large sterile towels soaked in warm saline solution.

c. Minimum duration of anesthesia. To cut down the duration of the operation and consequently of the anesthesia, the operator should work rapidly—as rapidly as is consistent with safety and accuracy—but accuracy must not be sacrificed to haste.

In this connection attention should be called to the fact that nurses and assistants may materially shorten the time under anesthesia by working rapidly in every step of the postanesthesia preparation. Here, again, accuracy must have first consideration, but that is no excuse for the slow, painfully slow, preparation so often seen. The most efficient nurse or assistant will execute the steps of the preparation **rapidly** as well as accurately and thus reduce the anesthesia time and the operative strain.

3. **Injury to Adjacent Organs.**—The ureter, the bladder, and the intestines are the organs particularly liable to injury in difficult cases. Ordinarily an injury of any of these organs occurring in the course of an operation must be repaired at once or at the close of the operation, and anyone doing pelvic surgery must be prepared to take care immediately of the injuries mentioned.

4. **Foreign Bodies Left in the Abdomen.**—The absolute certainty of the removal of all articles carried into the peritoneal cavity is a subject that deserves most careful consideration. It is surprising how easily and quickly the intestinal coils will enfold an object and carry it out of sight and touch. The prevention of this by the use of continuous gauze-strip sponges and long instruments has already been mentioned under the "preparation of instruments and dressings."

VAGINAL SECTION

Vaginal section is incision through the vaginal wall into the peritoneal cavity. If the entrance is made behind the cervix, it is known as "posterior" vaginal section. If the opening is made in front of the cervix, it is known as "anterior" vaginal section.

In some cases of pelvic disease it is better to enter the peritoneal cavity from below; i.e., by vaginal section; while in other cases it is better to enter from above; i.e., by abdominal section.

Advantages

Of Vaginal Section

The advantages of vaginal section, in suitable cases, are as follows:

1. Less danger. There is less exposure and handling of the intestines and peritoneum. In vaginal section the manipulations are confined to the pelvic cavity, while in abdominal section the central portion of the great peritoneal sac is invaded; therefore in vaginal section there is less shock and less danger of general peritonitis. Again, if infection should devlop after vaginal section, it is very likely to be "walled off" from the general peritoneal cavity and to cause simply local suppuration, whereas when infection appears after abdominal section it is very likely to take the form of an acute general peritonitis.

2. Evacuation of pus without contamination of peritoneal surfaces. This is one of the strongest points in favor of vaginal section in suitable cases. As a rule, when there is a large collection of pus that can be reached from below, it should be evacuated that way. This is particularly important if the pus be of recent origin. In such a case it is very important to prevent soiling of the peritoneal surfaces with this infectious fluid. This is accomplished by opening from below.

Again, in many cases of pelvic suppuration, the pelvic cavity, containing the abscess, is entirely shut off from the general peritoneal cavity by a wall or roof of inflammatory exudate, which binds together the upper pelvic structures. When operating from below we work beneath this roof, which protects the general peritoneal cavity from contamination.

3. Better drainage. In vaginal section the opening is made at the lowest part of the pelvic cavity—the best place for drainage.

4. Quicker convalescence. There is less disturbance of the intraabdominal structures. Also the wound is smaller, better protected and supported by surrounding parts, and is not so likely to be followed by hernia.

5. No visible scar. This is of some importance. A long scar marking the site of a former opening into one's interior is not particularly pleasant for the patient to contemplate. It is an ever present reminder of the disease that was present and of the operation. It is well to avoid making such a scar in cases where other methods are just as good.

6. Vaginal section combines easily with certain plastic operations, which are sometimes indicated at the same time.

Disadvantages

The disadvantages of vaginal section are:

1. Lack of room in the operative field. The manipulations are cramped and are carried out with less certainty of accomplishing the desired result.

2. Imperfect exploration of pelvis and lower abdomen. The pelvic structures are harder to reach and the lower abdominal structures (appendix, etc.) cannot be satisfactorily reached at all. And of the structures reached, the determination of their condition must usually be made almost altogether through the sense of touch, for the structures can be only imperfectly exposed to sight.

3. Remnants remain. Where the adhesions are extensive there is likely to be imperfect work unless the uterus is removed, and in many cases it is not advisable to remove the uterus.

4. There is not so good a chance to determine whether or not the conditions are favorable for conservative work on the ovaries or tubes, and the work itself, when indicated, cannot, as a rule, be so satisfactorily executed.

5. Appendix affections cannot be satisfactorily handled. The appendix is diseased and requires removal in a considerable proportion of patients with pelvic disease.

Selection of Cases

The operative cases in which the authors consider the **vaginal operation preferable** to the abdominal are:

1. Acute infection in the pelvis that has not yet spread to the general peritoneal cavity. This acute severe pelvic peritonitis is seen principally in cases of sepsis following labor or abortion. If general peritonitis is present, abdominal section is preferable.

2. A collection of pus low in the pelvis within easy reach of the fingers, particularly if there is a probability that the general peritoneal cavity is well walled off above.

3. For exploration of the pelvis in certain doubtful cases when it is evident that all the information required can be determined from below.

The operative cases in which the authors consider **abdominal section preferable** to vaginal section include:

1. Chronic inflammatory lesions, with or without a collection of pus.

2. Cases of adherent retrodisplacement of the uterus.

3. Cases in which conservative work on ovaries or tubes is probably required.

4. Ovarian and broad ligament and uterine tumors (except certain myomata that can be satisfactorily removed from below).

5. Extrauterine pregnancy (except where all that remains is a walled-off hematocele).

6. Cases complicated with, or probably complicated with, appendix trouble.

7. Obscure cases, requiring thorough examination of the pelvis and lower abdomen.

PREPARATIONS

For Vaginal Operation

The preparations for vaginal operation are practically the same as for abdominal operation, except that in the preparation of the operative field comprising the external genitals and vagina, some special measures are employed.

The day before operation, the external genitals and adjacent surfaces are shaved, and an antiseptic vaginal douche is given. Then about half an ounce of an acriflavine mixture (1 per cent neutral acriflavine in glycerin) is injected to the vaginal vault and left in place, a pad being applied. Early the next morning another acriflavine injection is made.
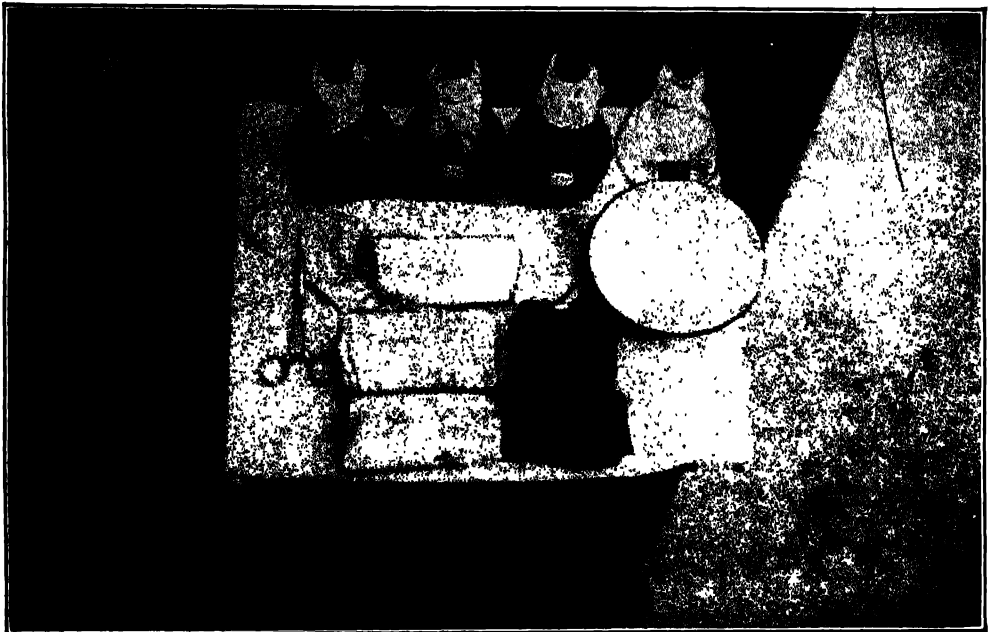
Fig. 1110.—Preparation of operative field. Preparation stand, with picric solution, iodine solution, alcohol, sterile bowl, gloves, forceps, and gauze pieces. On the lower shelf of the stand is placed a basin containing sterile catheter, towels, vaginal speculum, and vaginal forceps. This basin on the lower shelf is shown in Fig. 1111. (This series from Crossen and Crossen—*Operative Gynecology*.)

Bacteriologic studies, particularly in regard to anaerobic infections per vaginam as investigated by T. K. Brown, indicate that in preoperative preparation of the vagina it is advisable to make long-continued application of an antiseptic in a penetrating medium, in order to reach the bacteria deep in the vaginal folds and epithelium.

When the patient is on the operating table, the vagina and external genitals are scrubbed with soap solution, rinsed in sterile water, and then with bichloride or cyanide solution. In cutting operations, 3 per cent iodine solution is applied as desired by the operator. The articles for the antiseptic preparation and the arrangement and draping of the patient are shown in Figs. 1110 to 1113.

Fig. 1111.—Preparation of operative field. Patient in position for preparation of the operative field, and the preparation stand brought conveniently near.
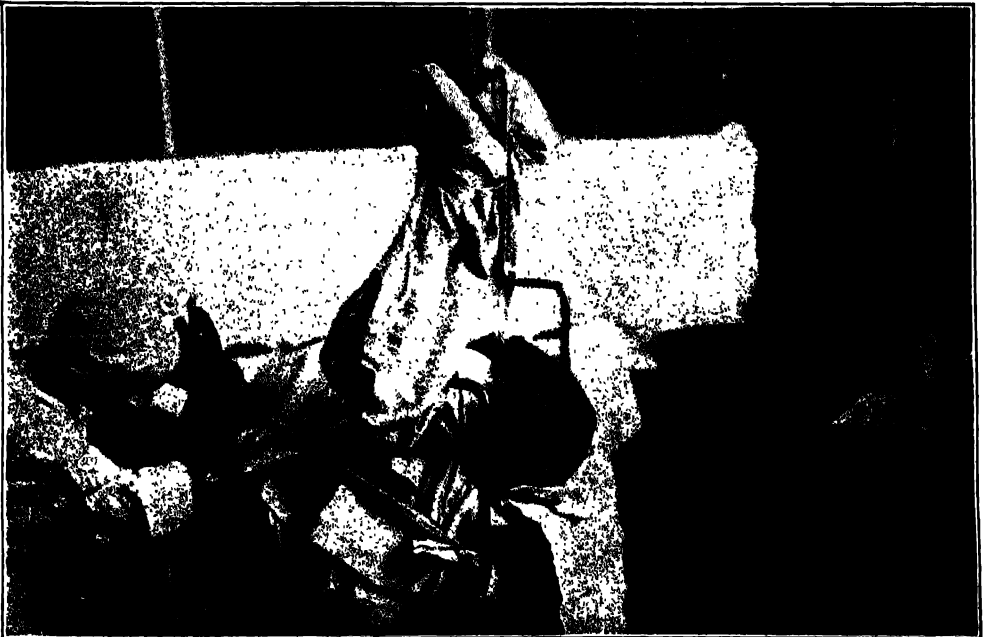
Fig. 1112.—Preparation of operative field. Patient's feet elevated ready for draping with the sterile sheet. This elevation of the feet puts them out of the way of the operative work, and enables the assistants to stand so they can observe and assist satisfactorily.

Instruments and Dressings.—The preparation of instruments, sutures, gowns, dressings, etc., is the same as for like articles for an abdominal operation.

In vaginal work numerous small gauze pieces of the "ten" and "twenty" type are required, and cotton balls, also, should be at hand, for use especially in curettage. In hysterectomy and in vaginal section, one or two large flat gauze sponges, with a long tape attached, should be provided for introducing into the pelvis to hold the intestines out of the way.

Fig. 1118.—The operator and assistants grouped about the field, beginning the operation. Notice that the patient's feet are out of the way so that the assistants can get at the operative field to observe and assist intelligently. The nurse (at operator's left) is standing beside her table ready to hand sutures as needed.

For vaginal operative work it is convenient to have three lists of instruments—List A, List B, and List C.

List A specifies the instruments needed for curettage and excision of specimen from cervix and radium application to cervix or within the uterus. List B specifies the additional instruments to be added to List A to provide for repair or excision of cervix, repair of pelvic floor, and plastic operations at vaginal outlet. List C specifies the additional instruments to add to Lists A and B to provide for anterior or posterior vaginal section or for vaginal hysterectomy.

Fig. 1114.—Fastening a retention catheter by "four point" fixation. This is an effective method of maintaining the catheter securely in position. *A*. The catheter in place and ready to be fastened. *B*. The upper long narrow adhesive strip has been fastened to the skin on the left side and brought once around the catheter and is being fastened to the skin on the right side. *C*. The lower adhesive strip has been similarly fastened to the skin on one side, brought once around the catheter and fastened to the skin on the other side. *D*. The dressing and T-bandage applied, with the catheter extending out to one side. When the patient is put to bed, the catheter will be connected with tubing to convey the urine to a bottle tied to the side of the bed. Patient's skin is prepared with picric acid solution. We formerly used this for the skin preparation but have discontinued its use because of frequent idiosyncrasy to it.

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Fig. 1113.—The operator and assistants grouped about the field, beginning the operation. Notice that the patient's feet are out of the way so that the assistants can get at the operative field to observe and assist intelligently. The nurse (at operator's left) is standing beside her table ready to hand sutures as needed.

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In arranging the patient in position for the operative work, the **feet and legs should be raised** far enough to carry them out of the way of the assistant standing at each side, as well shown in Figs. 1112 and 1113. This arrangement puts the operative area in the best position for the operative work and, the patient's feet being out of the way, the assistant on each side can stand close to the field and see and assist to the best advantage. If the leg-supports do not elevate the feet sufficiently to give plenty of room for the assistants, a moderate outward twist of each support will assist materially.

Catheterization in the operating room immediately preceding operation is advisable as part of the routine preparation. It gives an entirely empty bladder, which tends to prevent injury in extensive pelvic operative work and also facilitates accurate examination in those cases requiring deep palpation under the anesthesia. Catheterization in the operating room has the advantages that it is carried out under better antiseptic precautions and with less trouble and loss of time than in the patient's room, and also prevents troublesome accumulation of urine between catheterization and operation. In the exceptional cases where catheterization is not advisable, a word in time to the preparation-assistant will eliminate it.

Another point of importance in vaginal work is to arrange the sterile coverings about the vaginal opening in such a way that the rectum will be kept covered. Unless such care is exercised in the various manipulations in the course of the operation, the rectum may become exposed sufficiently to permit contaminating contact of sutures or instruments or the operator's gloved fingers.

Another point is the free use of citrate solution during curettage, to prevent clotting. The top of the vagina should be filled with the solution before using the curette, so that the introduction of the curette carries citrate solution into the uterus. Also, it is well to keep adding citrate solution as the curetting progresses. Otherwise the curettings become lost in a mass of blood clot, which interferes with their separation and preparation for the laboratory work.

Again, in investigating the depth of the uterus preliminary to curetting, it is well to use a cotton-tipped forceps instead of the uterine sound, as the latter may easily go through a diseased uterine wall into the peritoneal cavity.

If a retained catheter is needed after operation, it should be fastened by **four-point fixation,** as shown in Fig. 1114. If not securely fastened in all directions, it is likely to be found pushed out after a time.

AFTER-TREATMENT IN OPERATIVE CASES

ABDOMINAL SECTION

The details of the care of a patient after abdominal section may be divided into (A) the regular after-treatment and (B) the care in special conditions.

(A) **REGULAR AFTER-TREATMENT**

First Thirty-six Hours.—During the operation the patient's bed should be warmed with hot-water bottles placed under the blankets. When the patient is placed in bed, the hot-water bottles are distributed about her, to maintain the heat and diminish shock. Care should be taken to avoid leakage from any bottle, and that a thick blanket is kept between the hot bottles and the patient. Much discomfort and even serious injury may be caused by leakage from a bottle, or a too thin protective covering between the bottle and the patient. In several instances legal complications have resulted, involving the nurse or the hospital, or the physician.

The patient's head should be low (no pillow under it) until she has recovered from the anesthetic. Keep the patient quiet and let her sleep as long as she will from the anesthesia. If the patient vomits, she should be turned well over on the side to cause the vomited material to run out of the throat, that there may be no chance of its getting into the larynx and choking her. Death may occur from this cause.

The **orders** for the day of operation and first postoperative day are usually about as follows:

Fifteen hundred c.c. of normal saline solution to be given subcutaneously immediately on return to bed. Foot of bed to be elevated for six hours, except in drainage cases.

Codeine, gr. i, hypodermically, every two hours when awake. If after two or three doses the patient is not asleep, give morphine, gr. ⅙, hypodermically. When necessary to thus supplement the codeine with morphine, continue the codeine after that as before, i.e., every two hours when awake. The morphine is not to take the place of the codeine, but only to supplement it when necessary to give sleep. Sodium amytal, gr. vi, or nembutal, gr. iii, in 5 c.c. of water, given per rectum, is better than morphine for restlessness. If preferred, the medicine may be given by suppository.

Water may be given by mouth as soon as the patient desires it, either hot or cold, as best retained. The water should be given only in small amounts, but may be given frequently unless there is persistent vomiting.

Patient may ordinarily be propped up to void. If unable to void after the usual expedients (warm water to genitals, pressure on bladder, etc.), catheterize at eight-hour intervals or oftener if bladder fills.

When catheterization has been necessary and the patient is again beginning to void, she should be catheterized once daily for residual urine, until the residual urine is less than 10 c.c. After catheterization always irrigate with 4 per cent boric solution and then instill 10 c.c. of 1 per cent protargol solution.

When a retention catheter is in place, irrigate the bladder twice daily with 4 per cent boric solution, and instill 10 c.c. of 1 per cent protargol solution every other day.

It is not necessary ordinarily for the patient to be kept lying on her back. She should be turned frequently during the first several days, to avoid pulmonary congestion.

As a rule, we prefer to let the patient have water in small doses as soon as she wishes it. It diminishes the thirst and helps to supply the system with needed fluid. Occasional vomiting does no harm; rather it is beneficial in that it helps to clear out the ether-saturated mucus, the retention of which increases stomach irritation and disturbance.

If there is persistent vomiting, and especially if there is persistent epigastric pain, a nasal tube should be introduced and the stomach washed out with a quart of normal saline solution.

This stomach washing (lavage) has come to be recognized as a most important measure in postoperative treatment. It is the only effective treatment for the serious complication of acute dilatation of the stomach, and in any case of persistent stomach irritation it adds much to the patient's comfort by clearing out the irritating material.

In the cases of persistent vomiting and dilatation of the stomach it may be left in place and washing done every hour until the stomach begins to empty itself. Lavage should be resorted to promptly when indicated. Because of the minimum discomfort of the small tube, it is decidedly preferable to the regular size stomach tube.

If the patient cannot take water by mouth, the thirst may be diminished by saline solution under the skin. If the patient is in shock, start the subcutaneous saline at once, and also give glucose (10 per cent solution) intravenously or transfusion if needed.

Second Postoperative Day.—During the second postoperative day the orders previously given are continued unless there is some special reason for modifying them. The patient may take water more freely, and the liquid nourishment is now begun and gradually increased as the stomach will bear it. For this purpose any liquid except milk is permissible: broths, albumin water, fruit juices, tea, etc., as best retained by the patient.

If the patient has to be catheterized, it is well to give some reliable urinary antiseptic to diminish the danger of cystitis. If gas in the intestines is troublesome, a rectal tube may be introduced. Prostigmine aids the moving of gas by intestinal peristalsis, but it is contraindicated in intestinal obstruction.

If the operation was an emergency one, where there was no opportunity for preliminary preparation of the intestinal tract, it may be advisable to secure a bowel movement within the second twenty-four hours, in which case an enema of magnesium sulphate oz. i, glycerin oz. ii, and water oz. iv, may be given. This may also be used in those cases in which the rectal tube does not relieve the gas pains and distention.

If the patient has a retention catheter, it is usually removed on the second or third day; and then catheterization for residual urine is done once or twice daily, depending on the amount, until the residual urine is less than 10 c.c. Protargol solution is instilled after each catheterization. If there are 100 c.c. of residual urine, it is best to replace the retention catheter to avoid overdistention and consequent partial paralysis of the bladder muscle.

Third Postoperative Day.—At the beginning of the third postoperative day start the patient on the regimen indicated below, that a bowel movement may be secured some time during this twenty-four hours.

The **orders** for the third postoperative day, usually booked the afternoon of the second, include the following:

Magnesium sulphate and glycerin enema, morning of the third day. Continue the codeine as necessary to give rest.

In those cases in which there has been persistent vomiting or distention, continuous gastric drainage through a nasal tube connected to a suction apparatus and frequent enemas are used. Pitressin or prostigmine may be given if a mechanical obstruction can be ruled out. Five cubic centimeters of uritone are given intravenously as a urinary antiseptic.

The saline solution and the glucose should be stopped as soon as the patient is taking sufficient fluids by mouth, as indicated by the output of urine.

Fourth Postoperative Day.—Ordinarily by this time one or two good bowel movements have been secured, and the patient has become fairly comfortable. All medicines may now be given by mouth. The patient may be propped up as necessary to aid in urination if she is not already urinating. Some semisolid and solid articles of diet (custards, breakfast foods, toast, crackers, bread, etc.) may be allowed. As a rule, no sedative is now necessary, except an occasional dose of sodium bromide when the patient is particularly restless at night. It is well to start the patient on some good tonic, for these patients are usually anemic.

The **orders** given at this time may serve as standing orders, to be continued as long as the patient is in the hospital, except when modified for some special indications. They are about as follows:

Light diet, increasing to regular, as tolerated. Give an abundance of water and liquid nourishment. Articles from the regular diet may be added as desired.

Continue the iron preparation.

Continue the urinary antiseptic, if needed.

Mild laxative (mineral oil, phenolphthalein, or cascara) at night as needed. Give an enema when there is no bowel movement during the day.

Subsequent Orders.—The *care of the bladder* is an important item after pelvic operations. The urinary antiseptic should be continued until danger of urinary infection is past—ordinarily about a week after the bladder is emptied spontaneously. Curtis demonstrated that unsuspected residual urine is the most common cause of postoperation cystitis. When a patient has to be catheterized at all after operation, catheterization with the accompanying irrigation should be continued at least once daily, immediately after urination, until all residual urine disappears. By following this plan, Curtis was able to eliminate practically all postoperative bladder troubles. Uritone, 5 c.c. intravenously, is given until the patient can take medicine by mouth. Te Linde used 1 per cent mercurochrome to stimulate bladder tone.

The **diet** is gradually increased until the patient is taking regular diet with extras. She should continue to take liquid nourishment between meals. If during convalescence the patient does not take and digest sufficient food, the digestive powers may be increased by massage, passive movements and resisted movements, judiciously administered by a competent nurse. The careful carrying out of the regular nursing given bed patients (including the daily morning bath and evening alcohol rub) is also an important factor in

causing the patient to be comfortable and to rest well at night, and to digest her food promptly. If the patient is anemic, liver, spinach, and carrots are included in the diet, and iron, as ferrous sulphate, gr. v three times daily, may be given.
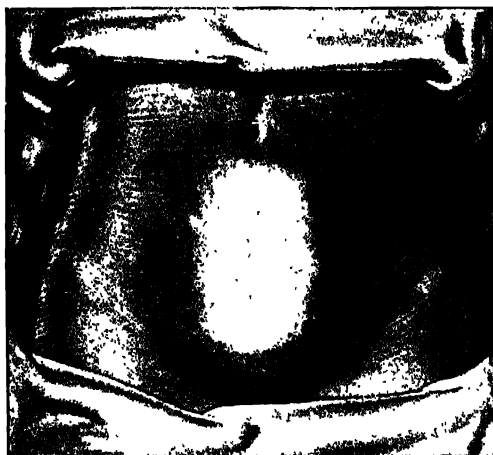
Fig. 1115.   Fig. 1116.

Fig. 1115.—The sutures removed and the area powdered freely with boric acid A large amount of the boric acid powder should be used, as it absorbs moisture and prevents itching and irritation. (Figs. 1115-1125 are from Crossen and Crossen— *Operative Gynecology.*)

Fig. 1116.—The flat gauze applied, ready for the strapping.

Fig. 1117.   Fig. 1118.

Fig. 1117.—The two diagonal strips of two-inch adhesive plaster applied. These should be long enough to take firm hold at the sides, so there is no chance of their loosening and coming off. They should be applied with moderate tension, as here indicated, to give good support.

Fig. 1118.—The transverse strips applied. These also should be long enough to take firm hold at the sides. Plenty of adhesive plaster should be used, so as to form a support which will permit the patient to be up and about without any possible danger of the newly healed wound being burst open by sneezing or coughing or other strain.

Removing the Sutures.—Unless there is some indication of irritation in the wound, the dressing is not to be disturbed for ten days. Then it is taken off and the sutures removed. The wound is now healed. The vicinity of the wound is dusted freely with boric acid powder, a smooth piece of gauze (several thicknesses) is laid over the scar, and the **abdomen is strapped** with strips of

two-inch adhesive plaster (Figs. 1115 to 1118) in such a way as to take the strain from the newly healed wound. From four to six strips are put on so as to give firm support. Then a piece of cotton is placed over all and the binder reapplied.

Fig. 1119.   Fig. 1120.

Figs. 1119 and 1120.—Subsequent dressings. In the later dressings, the adhesive strips are cut along the margin of the gauze, as indicated in Fig. 1119, and the gauze removed, exposing the scar as in Fig. 1120. After the required treatment, the fresh dressing is applied, and new adhesive strips are applied over the old ones. This obviates the frequent removal of the adhesive plaster from the skin, which is annoying to the patient and in some cases causes abrasions of the skin. New adhesive strips may be thus applied over the old ones three or four times if necessary, and, in the meantime, the adhesive first applied has become slightly loosened by the skin secretions, so that it comes off easier than if recently applied.

Fig. 1121.   Fig. 1122.

Fig. 1121.—The new dressing applied and the first new adhesive strip being put on over the old ones. With forceps or the fingers, the sides of the old plaster support are drawn tense, as here indicated, as the new adhesive strips are applied.

Fig. 1122.—The renewed adhesive support completed. Use as many strips as needed for secure support.

The adhesive strips are usually left undisturbed for about a week. If it is desired to look at the wound area, because of irritation along the suture tracts or for any other reason, the adhesive plaster is cut along the edges of the gauze (Fig. 1119) and the gauze removed so that the scar and vicinity are exposed (Fig. 1120). After the required treatment, gauze is again applied and then

new plaster put on, the ends of the new plaster adhering to the old plaster at each side (Figs. 1121, 1122). This permits inspection of the wound area as often as desired without the discomfort of repeated removal of plaster from the skin.

Ordinarily, however, the adhesive strips need not be disturbed until a week after the patient goes home. In the meantime a well-fitting corset or girdle, preferably the one she is accustomed to, is adjusted to the patient, to be worn after the adhesive is removed. The support is to be worn for about three months, but only when the patient is up and about. It may be taken off at night. Some authorities recommend that no abdominal support or binder be worn. But while most patients get along very well without it, the authors feel that it is a precaution which it is well to take. It is of decided benefit in some cases (where the abdominal wall is lax and protuberant), it adds to the patient's comfort in most cases, it is a safety guard in sudden strains, such as coughing, sneezing, or vomiting and it does no harm in any case if waist-constriction be avoided.

Sitting Up, Walking.—Unless there is some special reason for hurrying the patient to the sitting posture, she should be allowed to remain quiet and in the recumbent posture for the first few days. After the bowels have moved well, the patient should be encouraged to move about in the bed and to be propped up as much as she likes—more and more each day—so that by the end of the first week she is sitting up straight in bed. By the eighth or ninth day she may sit on the edge of the bed and be out of bed on the tenth day. The advantages of this early moving about in the bed and early getting up are better circulation (less "bed-weakness"), and consequently better repair of wounds, better digestion, and quicker restoration to normal condition.

The feeling of the patient is, as a rule, the best guide as to when to begin activity. In cases where the patient will be benefited by further rest, do not hesitate to keep her in bed two weeks, or even longer. In many instances the patient is greatly debilitated and literally "worn out" by chronic sepsis or by months of suffering and ill health, or by heroic work for her children in spite of failing strength. In all these cases, the enforced rest in bed may be an important aid in restoring the patient's health.

If the abdominal wall is found lax and atonic, as is so frequently the case, the "knee to chin exercises" described in Chapter III (Fig. 332) should be carried out regularly night and morning for several months after operation. They may be begun before the patient leaves the hospital or as soon thereafter as she finds she can carry them out without discomfort.

After the patient has returned to her home, the tonic medicines and regimen should be kept up for from three to six months, as necessary, to put the patient in good general health.

(B) SPECIAL CONDITIONS

1. **Drainage Cases.**—The drainage tube should be raised slightly and rotated once daily, in order to prevent injurious pressure on the rectum (which might cause perforating ulceration) and to prevent stopping-up of the drainage holes by omentum or bowel or exudate.

The tube is removed when the collection of fluid in the pelvis ceases—that is, in from two to five days. In suppurative cases the secretion, of course, keeps up indefinitely. In such a case, the tube is left in until all acute threatening symptoms have disappeared and until a good wall has formed about the tube tract, shutting it off from the general peritoneal cavity. It may, as a rule, be removed in from four to six days, and a small rubber tube inserted into the tract to keep the outer end open until it closes from the bottom. The treatment of such a tract is to keep it clean by cleansing (daily or less frequently, as needed) with hydrogen peroxide, keeping the outer end open as mentioned, and protecting it from secondary infection by an antiseptic dressing. It is well to keep some antiseptic drying powder (e.g., boric acid) dusted freely on the wound about the drainage tube.

Fig. 1123.—Elevation of the upper part of the body, to aid drainage toward the pelvis. This simple elevation of the head of the bed is employed immediately after operation and also at other times when the patient is too weak to be placed in the "half-sitting" or Fowler posture. The head of the bed is to be raised from eighteen to twenty-four inches (46 to 61 cm.)

In cases with extensive intraperitoneal suppuration, it is well to put the patient at once into partial Fowler posture by elevating the foot of the bed, as shown in Fig. 1123, and into regular Fowler posture (Fig. 1124) when sufficiently recovered.

2. **Uterine Replacement Cases.**—The principal special point in the care of the patient after any operation for fastening the uterus and adnexa forward, is to see that the bladder is not allowed to fill sufficiently to force the uterus backward again in the first few days following operation. If the patient cannot urinate, she should be catheterized often enough to prevent injurious distention.

Fig. 1124.—The Fowler posture. Head-rest elevated thirty to forty degrees. Slipping down in the bed may be prevented by placing a box at the patient's feet or by elevation of the foot of the bed or by a sling extending from the patient's hips to the head of the bed.
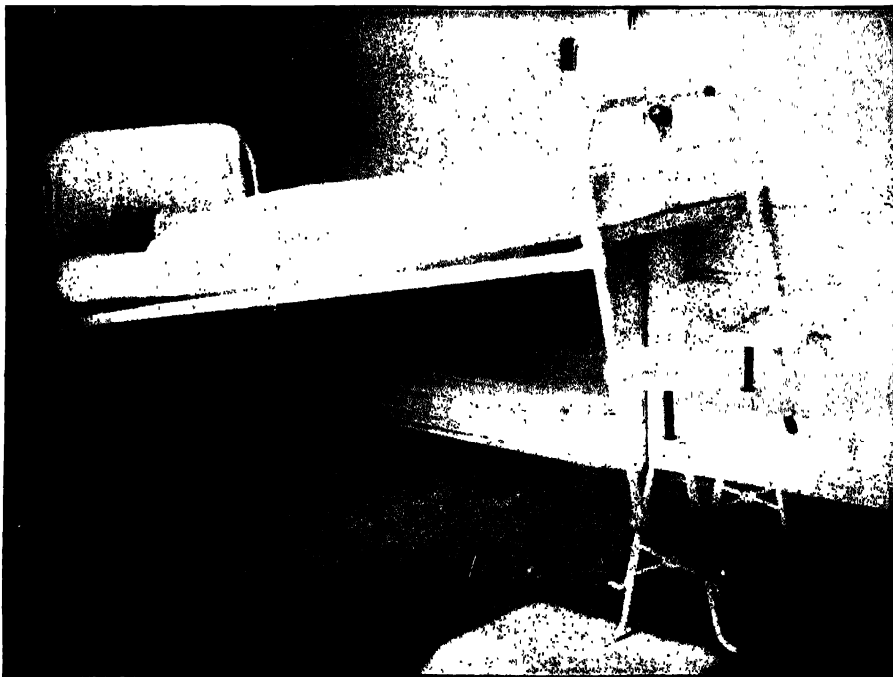

Fig. 1125.—Elevation of the lower part of the body, for the treatment of shock. The foot of the bed is to be raised from eighteen to twenty-four inches (46 to 61 cm.).

3. Severe Shock.—When the patient is in severe shock, the head should be lowered by the elevation of the foot of the bed about two feet as shown in Fig. 1125, except in those cases where there is danger of spreading pus from the pelvis to the upper part of the uncontaminated peritoneal cavity.

Give the patient quick stimulants, along with glucose intravenously and plasma or serum if available. If the shock is primarily due to hemorrhage, transfusion is indicated. The use of carbon dioxide is an additional measure of value where respiration is shallow.

4. Internal Hemorrhage.—A serious internal hemorrhage is indicated by rapid weakening of the pulse, an increase of pain in the abdomen, and subnormal temperature. It is rare after the first twelve hours, and usually comes within the first six hours. If there is a drain through the abdominal incision or into the vagina, there will be a free flow of bloody serum, or, if it is a tube drain, of blood itself.

The treatment of a slight hemorrhage is (a) to elevate the pelvis by raising the foot of the bed, (b) to put an ice bag on the pelvis outside the dressing, (c) to keep the patient perfectly quiet on her back, and (d) to give a sedative (codeine) if necessary to secure rest. Discontinue the saline or glucose solution. Do not give any stimulants or employ any measure that will increase the blood pressure. The hope is that, as the blood pressure is low, the bleeding will cease for a few hours—long enough to permit effective clotting to take place in the oozing area. In twenty-four hours such clots become so firm that a renewal of the bleeding is not probable. Fibrogen, 4 to 8 c.c. in ice water by mouth, aids in lowering the clotting time. If the patient is unable to take liquids by mouth, this can be given intramuscularly.

When there is indication that a vessel is still bleeding, the abdomen should be promptly reopened (if the patient is seen in time) and the bleeding vessel caught.

5. Persistent Vomiting.—To make the nausea and vomiting as slight as possible, the patient's head should be low (no pillow) for several hours after anesthesia. For the first day the patient should be kept perfectly quiet, with the eyes closed most of the time, so as to nap as much as possible. The nausea is increased by talking or by even looking about. If a visitor is allowed, it should be for only a few minutes and there should be no talking. When water is first given, it is preferable usually to give hot water, in tablespoonful doses and frequently, though some patients retain cold water very well from the first.

The most effective measure for overcoming vomiting, persistent nausea, and stomach distress generally, is washing out of the stomach with normal saline solution, as previously described. After the bowels are well opened the vomiting usually ceases unless there is some serious complication, such as beginning peritonitis or intestinal obstruction, both of which are mentioned later.

6. Acute Dilatation of the Stomach is a serious complication that may develop any time after operation, but especially within the first sixty hours. The patient complains of persistent pain in the epigastric region, and this region becomes more or less distended. The pulse becomes rapid and weak without apparent cause. There is usually nausea and vomiting, but the most constant and characteristic signs are the persistent epigastric pain and the failing pulse.

The anatomic change is overdistention of the stomach with gas, due to different causes in different cases. In the majority of cases it is probably due to some displacement of the stomach, with kinking and obstruction at the pylorus. As the gas cannot escape, its continued accumulation becomes a serious matter, and in several instances death has resulted from overdistention of the stomach caused thereby.

The treatment for this condition is prompt introduction of the stomach tube, to permit the gas to escape, and irrigation of the stomach with normal saline solution to remove all decomposing material and prevent reaccumulation of the gas by instituting continuous drainage, using suction if needed. This complication should be watched for and recognized, and the nasal tube used before it reaches a serious stage. If the trouble recurs, several stomach washings may be required. It is well also to vary the patient's position, so as to overcome displacement of the stomach and dragging on its supports. In some cases the condition is promptly relieved by turning the patient on the abdomen.

7. **Kidney Insufficiency** is more easily prevented than treated after it once develops. The preventive measure is to make sure that the kidneys are doing their work well before operation. The treatment for kidney insufficiency after operation consists in elimination by means of free bowel movements, and sweat packs and such other measures as are used for the regular treatment of uremia.

8. **Distention and Intestinal Paralysis.**-- When the laxative measures, given previously under the regular after-treatment, fail to cause bowel movement, the loss of function may be due simply to temporary paralysis of the bowel or to intestinal obstruction or to beginning peritonitis. Unless there are decided evidences of mechanical obstruction or of peritonitis, it is to be assumed that the trouble is temporary intestinal paralysis (adynamic ileus) and treatment for it is begun. This condition is one of the most serious of postoperative complications. It is due to the paralysis of a segment of the small intestine which, due to the lack of peristalsis, prevents the passage of the intestinal contents past this point. The results are the same as obstruction from kinking, adhesions, etc. There is the persistent vomiting, becoming fecal in the late stages, the distention not relieved by usual measures, and later the toxemia from absorption from the distended bowel. Peritonitis is easily ruled out early. Paralysis may be confused with obstruction from other causes and the differential diagnosis is difficult. X-ray examination may help.

The treatment consists in repeated washing of the stomach, and it is here that the duodenal tube left in place is of great value; repeated enemas such as magnesium sulphate oz. i, glycerin oz. ii, water oz. iv, s.s. enema with 1-2 dr. turpentine, saturated solution magnesium sulphate oz. vi (either alone or with olive oil oz. vi) aid in overcoming this condition.

The use of continuous duodenal drainage with the Wangensteen tube should be tried, and if relief is not obtained then the Miller-Abbott tube should be used. The details of the use of the Miller-Abbott tube are shown in the following account of the management of a case reported by Smith, Gehring and Wilson.

Upon the fourth day, Aug. 18th, the obstructive symptoms suddenly became more marked, resulting in fecal vomiting and increased distention and as a preoperative measure the Miller-Abbott tube was passed. This consists of a double chamber rubber tube about 11 feet long, one chamber for aspirating intestinal contents, and the other, an air chamber through which air can be forced to inflate a balloon at the end.

Abbott and Johnston have reported a number of cases of intestinal obstruction successfully relieved by the use of this tube, and in some instances rendering operation unnecessary. Its application reduces the distention of the gut proximal to the lesion, relieving the obstructive symptoms and rendering the patient a better surgical risk. As stressed by Miller and Johnston its prolonged use is contraindicated where a disturbance in blood supply of the involved loop with possible gangrene is suspected.

In our case the exact nature of the obstruction was not known, but it was felt that the intestine was not strangulated.

Fig. 1126.

Fig. 1127.

Fig. 1126.—The Miller-Abbott tube on 8/20/39, having completely traversed and decompressed the small intestine, lies with its tip and the inflated balloon at the site of obstruction near the cecum. Barium is shown distributed in the colon. (Smith, Gehring and Wilson—*Jackson Memorial Hospital Bulletin*.)

Fig. 1127.—Roentgenogram on fourth day of intubation. 8/22/39. All evidence of intestinal obstruction has disappeared. (Smith, Gehring and Wilson—*Jackson Memorial Hospital Bulletin*.)

The balloon was deflated and the tube passed through the nostril into the stomach. The suction was begun and the patient turned on to his right side. The tube was advanced inch by inch as in passing a duodenal tube, until the 75 mm. mark reached the nose. A roentgenogram revealed the tube coiled in the stomach. About six inches was withdrawn and $\frac{1}{150}$ gr. atropine was given hypodermically, hoping to relax the antrum. After advancement of the tube about a foot farther, x-ray examination revealed the tube following the characteristic duodenal curve. Thirty c.c. of air was injected into the balloon and the tube to the air chamber clamped. The tube was passed at the rate of 6 inches every half hour and the peristalsis allowed to draw the balloon through the intestine until the end of the tube had gradually worked its way to the point of obstruction in the right lower quadrant, completely emptying and deflating the gut on the way (Fig. 1126). The balloon was deflated and the tube left in place.

All symptoms had ceased on the fourth hospital day and a soft diet begun. It was felt that this food would be partly absorbed before reaching the point of obstruction which was apparently low in the ileum.

On the fifth hospital day the tube was clamped, but due to slight distention, suction was again started. Bowel movements began on the sixth day, feeding was resumed, and the tube was again clamped. A roentgenogram on the eighth day showed no evidence of obstruction, so the tube was withdrawn (Fig. 1127).

The patient was discharged on the following day and has had no recurrence of symptoms during the three months since elapsed.

This case demonstrates a typical mechanical obstruction in which the use of the Miller-Abbott tube was intended to convert an emergency operation into an elective surgical procedure, but which apparently effected satisfactory release of the obstruction, rendering operation unnecessary. The obstruction was probably due to kinking by adhesions and was perpetuated by the distention itself.

The use of the Miller-Abbott tube in this case illustrated well the help the roentgenologist can give to the surgeon in the management of a case of intestinal obstruction. By examining the upper gastrointestinal tract, a lesion of the stomach and duodenum was ruled out. During the same examination intestinal obstruction was diagnosed. In using the Miller-Abbott tube the possible dangers of barium in the intestinal tract proximal to the obstruction were obviated.

Active cooperation between the surgeon and roentgenologist is imperative if the fullest advantages of this method are to be realized. Both must share in the responsibility for successful intubation. Roentgenography makes passage of the tube a much less haphazard procedure. The progress of the tube must be closely followed with frequent roentgenograms. This makes possible the prompt detection of any delay and also the degree of decompression that is being effected. With the benefit of a complete visual record to supplement the clinical findings, the surgeon is equipped to proceed in the indicated direction with confidence.

By means of this effective "intestinal decompression," developed by the splendid work of Wangensteen and others, the intestine proximal to the obstruction is relieved of its irritating and toxic contents. Also, this part of the intestine can then be used for nourishing the patient until the obstruction is relieved. For the feeding, a preparation high in vitamins and proteins and carbohydrates is used.

Electrolytes and the serum protein-concentration can be maintained by the intravenous use of Hartman's solution and the amino acid preparation for intravenous use worked out by Elman. The danger of hypoproteinemia in surgical patients and the details of its effective treatment are considered at length in Chapter III. Much work has been done along this line also by Ravdin, Stengel and Prushankin, and in their article they review the literature.

A muscular stimulant to increase peristalsis, such as pitressin or prostigmine, may start the gas and other intestinal contents through the paralyzed loop. But if there is organic obstruction with constriction of a loop, increase of peristalsis may increase the tissue damage, swelling, and constriction and thus hasten thrombosis and devitalization of the loop. Consequently, extreme caution is necessary in the use of peristalsis stimulation in these borderline cases with uncertain local condition.

The chief indications are (a) to keep the intestine above the obstruction decompressed and quiet, so that the edema of the wall of the affected loop can subside and allow resumption of function, (b) to supply nourishment and fluids to the patient as above mentioned while nature is repairing the local damage, and (c) to empty the lower bowel gently with enemas, and thus encourage the passage through of material from above without unduly stimulating the bowel above. This active intestinal decompression plan of treatment eliminates the immediate toxic danger, lessens the increasing peristaltic dam-

age in the affected area, sustains the patient's strength while you are differentiating between functional and organic obstruction, and aids in that differentiation by eliminating the obscuring toxemia and distention and painful peristalsis.

9. Organic Intestinal Obstruction.—Definite organic obstruction by band or volvulus of course requires prompt operation when such diagnosis can be made. Unless operation is carried out promptly when local circulation is subjected to increasing organic constriction, thrombosis and devitalization of the affected loop will take place. The diagnosis is usually clear when obstruction with classical symptoms comes on suddenly some weeks or months after operation.

On the other hand, in the first few days postoperative, functional disturbance of one or more loops (from the necessary operative handling and separation of adhesions or from low-grade peritonitis) is much more frequent. Also, reopening of the abdomen is a much more serious matter in this early postoperative period. Consequently, all measures should be employed to rule out functional obstruction and make the diagnosis of organic obstruction definite before reopening. Additional help in such differentiation and in the management of this difficult problem will be found in the detailed case previously given, and also in the articles of Wangensteen, Miller, Abbott, Johnston.

Spinal anesthesia will sometimes relieve a functional obstruction. Consequently, in an uncertain case it is well to employ this, either as a diagnostic-therapeutic measure or as the type of anesthesia where operation appears necessary.

10. Peritonitis is indicated by the combination of symptoms consisting of fever (beginning or increasing after the second day), persistent vomiting (extending into the fourth and fifth days), serious increase in the pulse rate, steady pain in the abdomen (without the cramplike pains of intestinal obstruction), and an increasing tenderness and rigidity in the lower abdomen, which gradually spreads to the upper abdomen. The intestinal tract is usually sluggish (partial intestinal paralysis), but there is not the complete absence of bowel movement such as occurs in intestinal obstruction.

A rise of temperature within the first twenty-four hours after operation is not of serious significance. Not infrequently in extensive operations, involving large peritoneal or connective tissue surfaces, there is a sharp rise of temperature (up to 102° or 103° F.), coming on within twenty-four hours and subsiding the second or third day without further disturbance. In the absence of a more definite explanation, this "aseptic rise of temperature" is said to be due to the "absorption of blood ferment." But when there is a rising temperature after the second day, it is indicative of some unusual disturbance, and when the combination of symptoms above mentioned is present, the diagnosis of peritonitis is clear.

The treatment of peritonitis following operation is the same as for peritonitis without operation. Saline solution and glucose should be given freely, and also blood transfusion, with duodenal drainage and nourishment as needed.

11. Local Suppuration is indicated by fever, coming on after the sixth day, and a moderate increase in the pulse rate and localized pain. If the suppuration is deep in the pelvis, the patient complains of deep-seated pain and usually of backache or of pain extending down one thigh. If the inflammatory

focus is situated in the back part of the pelvis, bowel movement or the giving of an enema causes pain. Vaginal examination shows a boggy mass which is very tender. The treatment for such local inflammation deep in the pelvis is to secure good bowel movement, to make the patient comfortable, to increase tissue resistance and to await resolution or abscess formation. When fluctuation can be detected by vaginal examination, open and drain the abscess per vaginam. Exceptionally, it may be advisable to open into a solid mass (inflammatory focus without fluctuation) or to open into the cul-de-sac for general pelvic drainage.

When the suppuration is in the abdominal incision, there is increasing pain along the course of the incision. This calls for removal of the dressing and inspection of the wound. Inflammation at this point is indicated by the cardinal signs (pain, heat, redness, and swelling), localized at some part of the incision, or extending all along it. If the disturbance is slight, a hot moist antiseptic dressing, changed every twenty-four hours, may be sufficient. If there is a pronounced cellulitis at some point, that portion of the wound should be opened superficially and a gauze or tube drain put in and the hot moist dressing applied. If drainage of the infected area can be satisfactorily effected without removing the tension sutures, that is preferable. In some instances the inflammation is confined to the subcutaneous tissue and no disturbance of the deep buried sutures is necessary. The important point, however, is to secure free drainage of the infected area and prevent serious absorption. If the whole wound is infected, it must all be drained. In such a case, the whole wound (except the peritoneum) is likely to open. As soon as serious absorption has ceased, the sides of the wound are brought together by strapping with adhesive strips, the wound being exposed and cleansed every day or two (depending on the amount of discharge) with hydrogen peroxide. Later, if thought preferable, the granulating surfaces may be freshened by curetting and then brought together by sutures, with the idea of securing secondary union.

12. **Phlebitis** seldom occurs now, since patients are allowed out of bed earlier. When it does appear, it is usually in the third week, when the patient has passed the time for the ordinary operative complications and is congratulating herself that she will soon be entirely well.

She complains of pain in the groin and upper part of the thigh on one side, and the temperature gradually rises to 102° or 103° F. There may or may not be swelling of the foot and leg, but there is always tenderness on pressure over the femoral vessels just below Poupart's ligament. This tenderness may, in some cases, be traced a considerable distance down the thigh, and also up along the iliac vessels.

The treatment of phlebitis is immediate bandaging of the leg and thigh (from toes up), elevation of the leg in a comfortable position on pillows, and the maintenance of this position and of the dorsal posture for several days. In mild cases the measures mentioned usually relieve the spontaneous pain, but in severe cases sedatives may be necessary for a time to give rest.

It will be necessary to maintain this position most of the time for a week or more, depending on the severity of the trouble and the rapidity of the improvement. When the above-mentioned treatment is carried out promptly and persistently, serious trouble seldom results. If the patient is permitted to use

the leg, the suffering is increased and the disability prolonged, and there is danger of serious embolism by particles detached from the thrombosed area in the vein and carried to the brain or heart or lungs. On account of the danger of detaching emboli, no massage or rubbing of the involved area is permissible until some time after all acute symptoms have subsided.

Ochsner and DeBakey obtained excellent results in thrombophlebitis by procaine block of the lumbar sympathetic ganglia, as described in their article on the role of vasospasm in thrombophlebitis. They summarize their results as follows:

1. The concept that mechanical blockage of the venous and lymphatic systems is of primary significance in the production of the clinical manifestations in thrombophlebitis is, in our opinion, inadequate.

2. Based on recent clinical and experimental investigations, we believe that many of the symptoms and signs are due to vasospasm of the arterial and venous systems and that the vasoconstricting impulses originate in the thrombophlebitic segment.

3. As the result of vasospasm there result increased filtration pressure, relative anoxia of the capillary endothelium and diminution in the flow of lymph, all of which increase the amount of perivascular fluid.

4. By interrupting the vasoconstrictor impulses with procaine hydrochloride infiltration of the sympathetic ganglions, there is produced a reestablishment of the normal exchange of intravascular and perivascular fluids.

5. Fifteen patients with seventeen thrombophlebitic processes have been treated by procaine block of the sympathetics. These cases are characterized by the prompt and permanent relief of all clinical manifestations in contrast with the usual case of phlegmasia alba dolens, in which there is pyrexia for from four to six weeks and the likelihood of persistent undesirable sequelae such as edema, varicosities and ulceration.

6. There was prompt and permanent relief of pain in all instances.

7. In half the cases the temperature returned to normal within forty-eight hours and in the other half within one week.

8. In more than half the cases the edema completely subsided in eight days and in the remaining ones within twelve days.

9. Sixty per cent of the patients were discharged from the hospital as cured within eight days after the institution of therapy.

Getting patients out of bed early (at the end of a week or ten days) has almost eliminated this complication in the personal experience of the authors. Under the old regimen of keeping the patients in bed three weeks it was rather frequent, occurring in about 2 per cent of the abdominal operative cases.

13. **Pain During Convalescence.**—Aside from the conditions already mentioned and the natural soreness of the recently disturbed structures, pain during convalescence is usually due to gastric or intestinal indigestion, with gas formation and resulting painful intestinal peristalsis. The treatment for this condition is to remove the irritating material from the intestinal tract by an enema and laxatives, and, if necessary, to administer some remedy for the gastric or intestinal indigestion. Of course, patients who have been operated upon are subject to neuralgic and neurasthenic pains the same as other persons, and these are likely to be more pronounced at the menstrual time.

An abdominal operation often causes the menstrual flow to appear ahead of time. Not infrequently there is also a slight bloody flow from the uterus, without any relation to menstruation, within a few days after the operation. Such need occasion no alarm, as it disappears in a short time.

14. Subsequent Disturbances.—As the patient begins to walk about, there may be more or less soreness in the pelvis for some time, until the hyperemia of the healing tissues has disappeared and the new connective tissue is firm.

In drainage cases a sinus sometimes persists. The persistence of such a sinus may be due to sloughing tissue or to a ligature. In the case of a catgut ligature or sloughing tissue, the troublesome material will usually disintegrate and come away in the course of some weeks. The sinus tract, in the meantime, should be kept clean by frequent cleansing with hydrogen peroxide—every day or two, depending on the amount of discharge. The patient can care for the fistula at home after being shown how to apply the peroxide and the dressing.

If a silk ligature is at the bottom of the sinus, it may come out itself after some weeks or months, or it may have to be taken out. Sometimes it may be caught up by "fishing" with a silkworm-gut or other contrivance. Otherwise, it must be removed by operation. A rare cause of persistent fistula is a sponge or forceps left in the cavity.

Occasionally a **fistula** connected with the bowel follows abdominal section. Ordinarily such a fistula should be treated by a simple cleansing for some time, for in a considerable portion of the cases it will heal spontaneously within a few weeks. If it persists indefinitely, it requires operative treatment. Such an operation should not be undertaken lightly, for it may prove very difficult and dangerous.

A **hernia** in the scar indicates defective healing of the wound. This is usually due to the necessity for drainage, which prevents perfect approximation of the sides of the wound. If the hernia is small, it may in some cases be held back satisfactorily by an abdominal support. If large, or if persistently troublesome even though small, it requires operative treatment.

AFTER-TREATMENT IN VAGINAL OPERATIONS

The general after-treatment of vaginal operations is practically the same as for abdominal operations.

A lysol douche $\frac{1}{4}$ per cent or permanganate 1:5,000, once daily, is started on the third day. If there is a drain from the peritoneal cavity into the vagina, the douche should be given under very low pressure, making sure that there is a good return flow. By the end of a week the drain will have either come away of itself or be loosened so it can be easily removed. The douches are continued as long as the discharge continues. It is but seldom necessary to replace the drain.

After a vaginal or perineal operation, the vulva and adjacent surfaces must be kept covered with an aseptic dressing, the same as any other wound region. Here, however, on account of the necessity of evacuation of the bowel and bladder, the problem of wound protection is more complicated. The dressing must be changed several times daily and with each change of dressing there is danger of contamination.

When it is necessary to change the dressing, the nurse should disinfect her hands and then cleanse the operative field with an antiseptic solution (e.g.,

potassium permanganate 1:5,000). The cleansing may be conveniently accomplished by means of the "pitcher douche." After the cleansing, a fresh dressing is put on and the T-bandage again applied.

If preferred, the "dry" after-treatment may be used in vaginal cases. With this after-treatment no internal or external douches are given until ten days after operation. Sterile pads are changed as often as necessary.

In perineal cases, ointments applied once or twice daily may diminish the soreness and discomfort. If there should be much pain in spite of an ointment, a perineal ice bag will sometimes give relief. Also, sedatives are to be given if needed for sleep.

If the patient can pass the urine, she should ordinarily be permitted to do so, whatever the character of the vaginal work. Catheterization is more likely to do harm than urination.

In many cases, however, the patient cannot urinate at first, and must be catheterized for two or three, or more, days. Catheterization must be carried out under strict antiseptic precautions. The catheter is boiled, the nurse's hands are disinfected, and the vestibule and meatus of the patient are carefully cleansed with an antiseptic solution. After the labia are once separated and the vestibule cleansed, the labia must be kept separated, so that there is no recontamination of the vicinity of the meatus, until the catheter is introduced. Care should be taken to avoid touching the part of the catheter which enters the bladder. The catheter should be grasped well back from the point. In order to prevent cystitis, it is well to give the patient some reliable internal urinary antiseptic while she has to be catheterized and for several days after the urine is passed.

Where repeated catheterization is necessary for several days, it is better to fasten an ordinary soft rubber catheter in place with adhesive and keep the bladder drained for forty-eight hours. When the catheter is removed after this time most patients will be able to void. However, as previously mentioned, in these cases, catheterization with the accompanying bladder irrigation should be carried out at least once daily immediately after urination until all residual urine disappears.

The special points in the after-care in the various vaginal operations have already been given in the chapters treating of those operations.

MEDICOLEGAL POINTS IN GYNECOLOGY

There are various conditions connected with the genital organs concerning which the physician may be called to testify in court or to give a written opinion.

Such testimony is, generally speaking, simply the recitation of facts in anatomy, physiology, pathology, symptomatology, diagnosis, treatment, and prognosis, with which the physician is necessarily more or less familiar because of his daily work. But there are certain things, of little or no value in the ordinary diagnosis and treatment of diseases, which assume much importance when the case comes into court. So, when called to attend a case in which there is any probability of court proceedings, the facts that are of medicolegal importance should be given considerable attention.

Some of these facts in connection with certain subjects that frequently find their way into court will be pointed out here.

RAPE

Rape is defined as "the unlawful carnal knowledge of a woman without her consent," and again, more in detail, as "sexual intercourse with a woman effected by violence, or with a young girl by abuse of her ignorance."

Medical evidence is ordinarily required to confirm or disprove the statement that rape has taken place. False accusations of rape are very frequent. Taylor states that for one real rape tried in the courts there are, on the average, twelve pretended cases. Some of these cases of false accusation are founded on a mistake, as may happen with infants, children, and persons mentally defective. In other cases the accusations are made willfully and designedly for the purpose of extortion or revenge, or from another ulterior motive. In some instances the false accusation may be at once disproved by medical evidence, though it has happened that the medical man has been deceived and duped by designing persons. In many cases in adults the medical evidence is not decisive, and the truth or falsity of the charge must rest almost wholly on the statement of the prosecutrix herself along with the corroborating circumstances.

The question for the physician to decide as far as possible, from his examination, is whether or not sexual intercourse took place, or was attempted, at approximately the time indicated. Subsidiary information may be required; e.g., as to whether there were evidences of violence elsewhere on the body, or as to whether intercourse has ever taken place or has frequently taken place, or as to whether death was caused by the injuries inflicted, or as to whether disease was communicated at the time, and if so, what is the nature and probable outcome of such disease. On all such points the physician is supposed to be informed, and he is also supposed to keep such record of his cases as will enable him to testify with certainty, some years afterward, concerning his findings in any particular case.

For the consideration of the medical evidence of rape it is convenient to divide the cases into three classes, the first including infants and children, the second including young unmarried women, and the third including married women.

There are, however, certain points that should be kept in mind in all cases. When called to examine or treat a person on whom rape is alleged to have been committed, notice and record, as soon as you can conveniently, the following points, for you are likely to be questioned in court concerning them:

1. The precise time at which you were summoned, the exact hour and date of the examination, and the place of the examination. It is important in some cases to know whether or not the female, alleged assaulted, took the earliest opportunity to complain. Also, the exact time elapsing between the alleged assault and the examination has an important bearing on the signs found. The place of the examination at a certain time may be important as showing the truth or falsity of some statement of the defense or prosecution regarding the movements of the female shortly after the time of the alleged assault.

2. Marks of violence about the genitals.

3. Marks of violence on the body elsewhere or on the clothing of the complainant.

4. Presence of stains of spermatic fluid or of blood on the clothing. When the character of the stain is not clear, make a microscopic examination of the contaminating material.

5. The existence of disease probably conveyed in the alleged assault (gonorrhea, syphilis, chancroid).

The evidences of rape will vary with the age of the patient and other circumstances.

It may be stated that, to establish the fact of rape, it is not necessary to prove penetration into the vagina by the male organ. It has been decided that, if the evidence shows penetration of the vulva or to the vulvar cleft, that is sufficient—the legal establishment of the crime requiring only the fact of the penetration, the degree of penetration being quite immaterial. Consequently, the hymen is not necessarily ruptured, even in cases where entrance of the male organ into the vagina would be absolutely impossible without such rupture. Taylor, in his *Medical Jurisprudence* (American Edition by Clark Bell), states: "Medical men sometimes have fallen into error on this point, considering that, when the hymen was entire, rape could not have been committed, but the statute law says nothing about the rupture of the hymen as a necessary part of the medical evidence; it requires from the medical witness merely proof of vulvar penetration—this may occur and the hymen remain intact." However, laws differ, and in any case it would be well to look up the wording and interpretation of the law in the state or country where the alleged assault occurred.

Infants and Children

In the case of infants and children there are usually decided evidences of injury about the genital organs. Of course, such injury does not necessarily exist, but when it does not exist the proof of rape must rest largely on evidence other than medical. Again, where there are evidences of injury about the genitals in a child alleged to have been assaulted, it does not necessarily follow that the injuries are due to rape. The abnormal appearance may be due to some disease or to some accidental injury, or to some injury inflicted by a designing person with the object of deceiving the physician. All these

things must be kept in mind. In this, as in other situations, the physician's diagnosis of the conditions present and the interpretation of the meaning of those conditions must be founded on incontrovertible physical evidence that will stand attack from all sides.

The evidence of rape will, of course, vary much with the time that elapses after the occurrence before the child is seen.

1. If the child is **seen within a few hours,** the following conditions may be present:

a. More or less abrasion of the vulva and vaginal opening, with probably some bleeding or clots. If penetration into the vagina has taken place, there may be extensive injuries—tearing of the hymen, perineum, and vaginal walls into the rectum or even into the peritoneal cavity.

b. Evidences of violence elsewhere on the body or about the clothing— scratches or bruises on the body, tears of clothing, blood on it or disarrangement of it. In some cases the child has been rendered insensible by a blow on the head or by some drug administered.

c. Presence of semen in the vicinity of the genitals of the child or on the clothing. The contaminating material should be submitted to microscopic examination, that the presence or absence of spermatozoa (as a positive evidence of semen) may be determined.

d. Presence of gonorrheal pus on the genitals. The presence of pus about the genitals of the child does not necessarily indicate rape. The pus may have been put there, with blood and scratches, for purposes of deception. If microscopic examination of the pus shows gonococci, it has come, directly or indirectly, from gonorrheal inflammation in a male or female. Gonorrheal ophthalmia is a not infrequent form of gonorrheal inflammation, and the pus from such a condition in the mother or attendant may be responsible for the gonorrheal vulvitis in the child.

2. If the child is **seen after a few days** or a week or so, the following conditions may be found:

a. Acute inflammation, apparently due to violence. The fact that inflammation is present is established by the presence of a mucopurulent discharge, yellowish in color and staining the linen. This may not be present the first day or two, but after that it is ordinarily present if there has been much injury of the vulva or vagina. The inflammation is further indicated by the redness of the parts, the tenderness, and the pain on urination.

The acuteness or recent onset of the inflammation is shown by the severity of the process compared with its extent, the marked painfulness of the affected areas, the presence of recent abrasions and tears about the hymen and vulva, and possibly swelling from edema. The parts may be so painful that the child strongly resists any attempt to make an examination—even the separation of the thighs. This is of no diagnostic significance, as children with inflammation from other causes, or even with no inflammation, may do the same. If this obstacle to examination is extreme, it may be necessary to anesthetize the child in order to make the examination. If extensive inflammation is present, there may be fever, and in the very extreme injuries the most serious acute symptoms may develop. Several deaths from this cause, with consequent convictions for murder, have been recorded.

The fact that the inflammation was immediately preceded by violence or mechanical injury is shown by the evidences of recent tears or abrasions, or by ecchymoses due to

bruises from some cause, and also by the extent and severity of the inflammation in such a short time and without other apparent cause. Gangrene with sloughing of the external genitals and vagina and adjacent tissues has occurred from these causes, usually with fatal effect, though some have recovered after considerable sloughing.

Care should be taken to exclude similarly appearing conditions due to other causes. The very severe inflammation of the genitals called "noma" has more than once led to a mistaken supposition of rape. It is seen principally in debilitated children with severe acute diseases, such as scarlet fever, diphtheria, typhoid fever, etc. Occasionally, however, it occurs in apparently healthy children where the genitals are neglected and dirty, permitting some severe infection. It may follow marked bruising or injuries of the parts from any cause. It may follow even a comparatively slight injury in an otherwise healthy child. Taylor relates a rapidly fatal case in a child five years old who accidentally fell on some thorns, from which she sustained slight injuries, followed by a severe infection and noma and death. The condition of the parts, with the evidence of mechanical injury, was such that it might easily have led to a charge of rape, had the real cause not been known.

b. Gonorrheal inflammation in the acute state. Gonorrheal inflammation is likely to extend into the urethra, though the vagina may escape. The diagnosis of gonorrheal inflammation is established by finding gonococci in the discharge. The significance of the presence of acute gonorrheal inflammation depends on circumstances as already explained.

c. Evidences of chancroidal infection (Fig. 375).

d. There may be present some of the other conditions mentioned under the earlier examination.

The disturbance of the parts may be very slight, as shown in cases where other circumstances proved the rape. For example, an adult was convicted of rape on an infant only seven months old. According to the medical evidence the vulva was somewhat swollen, there was slight excoriation about the labia minora and a small amount of blood. The hymen was not lacerated, and there was no evidence of penetration past it. Seminal fluid was found on the person of the child.

The evidences of rape, when not severe, may very quickly disappear. Casper relates a case of a girl of eight years upon whom rape was committed by a man in a drunken condition. The girl was examined the next day. The labia were then reddened, and there was congestion about the vaginal entrance, which was very tender. Examination ten days later showed the genitals to be in their natural state, and there was nothing at that time to indicate that the girl had been subjected to violence.

3. An examination after some weeks or months may show no evidence of the disturbance, or may show one or more of the following conditions:

a. Chronic mucopurulent discharge from the vulva or vagina. This is present in many infants and young girls from simple causes, such as want of cleanliness, scalding from frequent irritating bowel movements, seat worms, irritating urine, adherent prepuce over clitoris, skin diseases of the vulva, pediculi, and various other sources of irritation about the genitals.

b. Chronic gonorrheal discharge from the external genitals or vagina. The fact that the discharge is gonorrheal is established by finding gonococci. If the beginning of this discharge can be fixed as about the time of the alleged assault, it is strong corroborative proof. Gonorrheal vulvitis and vaginitis occur, however, not infrequently from wholly different causes, as previously stated.

c. Evidences of syphilis or chancroid.

d. Laceration or destruction of hymen. The presence of the intact hymen does not preclude rape, as previously explained; neither does the absence of the hymen or apparent laceration of the hymen necessarily imply injury of the membrane by rape or otherwise, though the condition of the hymen might be strong corroborative proof in a particular case, especially if it could be established by the mother or the nurse, or a physician who had made an inspection, that there was, prior to the time of the alleged assault, a well-formed and apparently intact hymen. The hymen is very different in shape and appearance in different individuals. Occasionally it is practically absent in a child otherwise normal.

e. Abnormal size of vagina, as though it had been at one time dilated. Permanent marked dilatation is not very likely to follow a single distention by coitus or otherwise. This condition, which is found occasionally in older girls where the question arises, is due usually to repeated distention of the vagina, by coitus or otherwise, extending over a considerable period of time. In such cases, the parts may soften and relax to a remarkable extent, even leading to the suspicion that childbirth may have taken place.

f. Scars from injury of the genitals. The genitals are exceptionally well protected, and are not often injured, except by some disease process or in attempts at coitus. Occasionally a child will fall astride of some object and inflict an injury. Again, injury may come from attempts of the child to introduce some foreign body into the vagina, though such injuries are more likely to be found in girls somewhat older. Scars about the genitals may, of course, result from any severe inflammation or destructive process, and also from chronic inflammation of milder grade when it is accompanied by persistent scratching, with resulting ulceration.

Older Girls and Unmarried Women

In this class, the severity and certainty of the signs decrease and the difficulties of arriving at a definite conclusion increase. The mechanical injuries following coitus, or attempted coitus, are less marked and sooner disappear, and there remain fewer deviations from the normal. Again, in the case of older girls and adult women, the medical man is likely to be subjected to two lines of questioning—(A) as to whether or not coitus or attempted coitus took place at about the time of the alleged assault, and (B) whether or not coitus had ever taken place before, and, if so, whether several times or over a considerable period.

A. **Evidences of Recent Coitus or Attempted Coitus.**—The evidences found will, of course, depend to a considerable extent on the period of time which intervenes between the assault and the examination. If the examination is made within a few hours after the assault, one or more of the conditions previously mentioned may be found. The mechanical injury to the genitals is likely to be less because the parts are larger, and the epidermis less delicate and less easily abraded. The evidences of injury on other parts of the body are likely to be more marked because of the greater resistance which the victim is able to make.

If the examination is made after a few days or a week, the additional points already mentioned must be investigated. As the local injuries are less than in younger females, they will subside more quickly.

If the examination is made after several weeks or months, the problem for the physician resolves itself into determining whether or not sexual intercourse has ever taken place. The determination of the time when the coitus took place is ordinarily impossible after several weeks have elapsed. In certain cases the medical testimony may be strongly corroborative of other testimony in establishing the time of the assault, even after several months. For example, if it should be established by other testimony (a) that up to the time of the assault the young woman was perfectly well and had never had coitus, and (b) that immediately afterward she had a discharge and had been sick more or less ever since, and (c) that there had been no subsequent coitus—then the finding of a chronic pyosalpinx with chronic endometritis, in an examination some months later, would be strong corroborative proof that the infecting coitus took place about the time of the alleged assault.

Ordinarily, however, after a few weeks all the acute and subacute evidences have subsided, leaving only those that, so far as any distinctive characteristics are concerned, might have been there some months or some years. So the question here is essentially whether or not coitus has ever taken place in the case of the individual concerned.

B. **Evidences of Remote Coitus.**—Ordinarily, it is easy to tell, by a comparatively superficial examination, whether or not a girl or woman has probably had coitus. The differences in appearance of the external genitals and vagina when coitus has taken place (especially if it has taken place several times) are usually so marked that the physician has little difficulty in distinguishing them. This is the general rule. There are, however, exceptional cases which present many of the ordinary evidences of coitus when in fact none has taken place. On the other hand, there are persons who present signs which are considered almost pathognomonic of virginity when in fact sexual intercourse has occurred, and not only sexual intercourse, but pregnancy and labor at full term. So, in exceptional cases it may be very difficult to decide certainly whether or not sexual intercourse has occurred, and in such a case it is particularly difficult to legally prove it, for the anomalies must then be considered.

The evidences of remote coitus or attempted coitus can be summed up as follows:

1. Evidences of **previous childbirth** at or near term.

a. Destruction of the hymen, leaving only irregular tags here and there about the vaginal opening, with scar tissue between. This condition is very strong evidence of childbirth at or near term. It means that there has passed through the vaginal opening some body large enough not only to stretch and lacerate the hymen, but to stretch out the vaginal ring enormously, and to so stretch and compress and bruise the hymen that the subsequent sloughing and scar contraction have practically destroyed it. There is really no hymen that can be traced as a circular ring of tissue with simply laceration from intercourse. The hymen, as such, is gone, and there remain only irregular projecting particles of tissue (carunculae myrtiformes) here and there to mark the place where the hymen used

to be. Of course a large tumor, e.g., a myoma, delivered through the vagina might do the same. Also, some destructive inflammatory process or serious injury during childhood or later might produce practically the same result, but such conditions are rare and show also other evidences. There are cases of congenital deformity in which the hymen may be present simply as irregular tags of tissue, or it may, as recorded in some cases, be absent altogether. In such cases, we would not expect the scar tissue about the vaginal opening or the marked enlargement of the opening. So the destruction of the hymen as described, when present, is strong presumptive evidence of previous childbirth.

Suppose the hymen is not destroyed—does that prove that no childbirth has taken place? Not necessarily. Occasionally during labor the hymen is simply torn and then the ring beyond it is stretched and torn. After labor, the portions may heal in such a way that the hymen appears practically intact. Still rarer cases have been recorded in which the hymen softened and dilated sufficiently to permit the child to pass and then underwent involution to about its former size. Such a hymen is likely to stretch also during coitus instead of tearing. The examination of such a patient would show an ''intact hymen,'' or, as some, laying too much stress on the condition of the hymen, are wont to write, ''virgo intacta.'' The absurdity of such a designation based only on the condition of the hymen is well expressed by Taylor when he remarks, ''such 'virgines intactae' have frequently required the assistance of accoucheurs and have in due time been delivered of children.''

b. Evidences of laceration or great stretching of the perineum, vagina, and pelvic floor. These evidences are a large vaginal opening, close approach of the opening to the anus (partial destruction of perineal body), scars about the opening or on the perineum, lax vaginal walls, and lax pelvic floor. These have about the same significance as the destruction of the hymen above mentioned—that is, their presence is strong evidence of previous childbirth, but their absence is not of much legal significance.

c. Laceration of the cervix. The establishment of a distinct laceration of the cervix is very strong evidence of a previous parturition or operation involving division of the cervical wall. There are conditions that simulate a slight laceration, but a deep laceration would hardly be simulated by anything short of some congenital deformity, and in such a case there would be likely to be other deformities. Also, there would be no scar tissue, such as is ordinarily found about a laceration of the cervix.

d. Evidences of previous lactation. It may be possible to press some fluid from the breasts, or the breasts may show the enlarged veins and the white striae (lineae albicantes) of a previous distention.

e. Evidences of a previous distention of the abdominal wall. There may be present the striae (lineae albicantes) indicative of previous stretching of the skin from distention from pregnancy or other causes. When other causes (obesity, tumor, ascites) can be eliminated by the history, such striae indicate previous pregnancy. Also, marked relaxation of the abdominal wall may be due to previous distention by pregnancy.

2. Evidences of **previous abortion**. After a short time, the evidences are exceedingly uncertain in many cases. There may be some slight lacerations, with resulting scars, that may be corroborative evidence, especially partial laceration of cervix. Their presence may help some, but their absence is of no particular significance.

3. **Laceration of Hymen** and some dilatation and laxity of vaginal opening and vaginal canal. These are the ordinary evidences of coitus and are nearly always present, especially if repeated coitus has taken place. Usually the opening in a virgin hymen is so small that the introduction of one finger is effected with some difficulty and causes pain. Ordinarily, after repeated coitus, the vaginal opening admits two fingers easily for examination, and without pain, provided the perineal edge of the opening is carefully depressed.

In exceptional cases the hymen may remain intact after coitus, particularly in those cases in which the opening is large and a little stretching will accommodate the male organ. Occasionally, however, a hymen with a small opening will remain intact. In such cases the hymen is usually elastic and unusually tough, and consequently it stretches and dilates under a force that would rupture an ordinary hymen. So that, though it may be said that there are many exceptions to the rule that "coitus ruptures the hymen," there are very few cases in which a hymen presenting the normal rupture capacity (or normal size, normally tense and having the normal consistency, elasticity, and strength) does not rupture on first coitus. In doubtful cases, then, the physician should take care to ascertain accurately, not only the presence of the hymen, but also its character.

The apparent laceration of the hymen or even the absence of the hymen, while presumptive evidence of coitus, is not positive evidence of the same. It may be absent wholly or partially from congenital deformity. It may have been destroyed or dilated by disease or injury in infancy, childhood or later life. It may have been lacerated by an operation or an examination. Its apparent laceration is, however, strong, corroborative evidence of coitus when taken in connection with the history of the case, and especially when there is reliable testimony establishing that it was formerly intact.

4. Evidences of a **disease** usually communicated in sexual intercourse, such as gonorrhea, syphilis, chancroid, pediculosis pubis.

5. Evidences of uterine or tubal **inflammation,** presumably due to infection following labor or abortion, or coitus.

Married Women

In married women normal sexual intercourse has, of course, already taken place, so that the establishment of the fact of coitus is of no help in establishing rape. The medical evidence, if any is required, must bear upon the question of coitus by some one other than the patient's husband and against her resistance.

The following points should be investigated:

1. Evidences of **injury about the genitals,** indicative of forced and hurried coitus. There may be abrasions, tears, bruises, or bleeding.

2. Evidences, elsewhere on the body or clothing, of **injury in resistance.** There may be bruises and scratches, or an excited or hysterical state, such as might be caused by a harrowing experience. The clothing may show tears or bloodstains, or contamination with dirt of the road, or disarrangement. Of course, none of these evidences of violence establish the crime of rape. They only go to show that something was attempted that excited the woman's resistance. They might have been due to attempted robbery or to a quarrel. Again, they may have been placed there intentionally. The woman may be trying to deceive for the purpose of extorting money or for other reasons.

3. Stains of **spermatic fluid** may be present on the clothing or person of the woman. If there is any suspicious stain, some of the contaminating material should be submitted to microscopic examination, that the presence or absence of spermatozoa may be determined. Any discharge in the vagina may also be examined microscopically, but the presence of spermatozoa in the vaginal discharge is not of much significance unless it can be established that no coitus with the husband has taken place for three or four days.

4. **Disease** (gonorrhea, syphilis, chancroid) not present in the husband.

The Question of Consent

The question of consent is often the crucial point on the legal side of these cases of alleged rape in adult women, whether married or unmarried. This question is, as a rule, decided largely or wholly by testimony other than medical. In some cases, however, the medical man may be required to give testimony concerning corroborative facts. An adult woman of ordinary health and strength is supposed to make strong resistance. In such a case, if there are no obvious evidences of resistance, the legal assumption is that consent was given and the case is not one of rape. It has been claimed that a strong woman can make effective resistance, and therefore that an accusation of rape by such a woman is an absurdity. "Some medical jurists have argued that a rape cannot be perpetrated on an adult woman of good health and vigor, and they have treated all accusations made under these circumstances as false." This view is too extreme, for there are circumstances and conditions that would make effective resistance impossible even by a woman of unusual strength, as when two or more are combined in the attack or when the woman is rendered powerless by terror or by exhaustion from long struggling with her assailant. The physician may be required to state his opinion regarding the possibility or probability that sexual intercourse could take place without the consent of the woman under various circumstances; for example, the following:

1. When a woman is weak from age, sickness, or other bodily infirmity. That coitus could be forced under such circumstances is evident.

2. Where there is imbecility or other form of mental irresponsibility. In such a case consent in the legal sense is impossible.

3. When the woman is attacked by several persons or by one person of superior strength. Rape is unquestionably possible under such circumstances.

4. Where there is unconsciousness or partial unconsciousness from narcotics or intoxicating liquors. Coitus may take place under such circumstances without the consent, and in some cases even without the knowledge, of the woman. Many young women are ruined in this way in the "wine-rooms" of our cities. This fact is recognized in the law which makes it a crime to give a woman intoxicants with the intention of stupefying her, so that coitus may take place without her consent.

5. When there is unconsciousness or partial unconsciousness from a general anesthetic, such as chloroform or ether or laughing gas. The fact that rape may, and occasionally has, been, committed under these circumstances is sometimes taken advantage of by designing persons to extort blackmail from dentists and others who must, in their work, anesthetize or partially anesthetize patients without a third party present

Anesthesia or partial anesthesia of a girl or woman without a third party present is hazardous for another reason. The patient, while going under the anesthetic or recovering from it, may experience certain feelings or hallucinations that cause her really to believe and firmly proclaim that sexual intercourse took place. Many such cases of false accusations, honestly made, are on record. In one instance "a young lady was accompanied to a dentist by her affianced lover, who never left her while the anesthetic was administered and a tooth extracted; yet she could scarcely be convinced subsequently that the dentist had not attempted to ravish her."

6. When there is unconsciousness or partial unconsciousness from hypnotic sleep. Convictions have occurred of undoubted rape under this condition. Also, false accusations may be honestly made from sensations experienced in this condition. This comes under partial or complete anesthesia. Another source of false accusations, honestly made, is mental aberration of various kinds—from well-marked insanity to the various functional nervous disturbances.

7. When there is unconsciousness or partial unconsciousness from fainting, syncope, an epileptic seizure, a fall or a blow.

8. When the woman is temporarily helpless from terror or from an overpowering feeling of horror at her situation.

9. A woman may cease her resistance under threats of death or duress.

OTHER CONDITIONS

Presenting Medicolegal Points

1. The various medicolegal questions concerned with the state of pregnancy, abortion, labor, and the puerperium belong more strictly to obstetrics, and need not be considered here.

2. The question of the character of a disease present—particularly gonorrhea, syphilis, or chancroid—and the source from which it could have come, and whether or not it is still transmissible, are all questions that may assume medicolegal importance under various circumstances; for example, in suits for divorce, suits for possession of children, suits for alimony, suits for damages against individuals or corporations, etc. Also, of injuries of the genital organs you may be called to give the nature, extent, possible cause, and probable outcome. All these are simple clinical questions, and the information regarding them may be obtained from the clinical portions of this work.

3. Various questions in regard to sterility may come up in legal inquiries. The required information on this subject is given in Chapter XV.

4. In the case of the death of a woman or girl under suspicious circumstances, the physician may be called upon to make a postmortem examination and then to answer, as far as possible, various questions, among which may be the following:

What pelvic lesions were present?

What was the probable cause of these lesions?

What was the cause of death?

5. In coroners' cases, and much more so in malpractice suits (before or after death), the following questions may be asked concerning almost any gynecologic disease:

What disease is present?

What are the principal points upon which your diagnosis is based?

In your opinion did the attending physician use reasonable care and skill in the diagnosis?

What is the established treatment for the disease?

In your opinion did the attending physician use reasonable care and skill in the treatment?

6. In criminal cases and in damage suits the physician testifying as an expert may be required, particularly in the cross-examination, to explain in detail various points in the etiology, pathology, symptomatology, diagnosis, treatment, and prognosis of the affection under consideration. To answer such questions, the physician must be well grounded in all the important facts and theories of the disease, and must be able to give the required explanations in a few words and in ordinary language, avoiding the little-understood technical terms.

On important contested points it is well to be fortified with the names of two or three recognized authorities on that particular subject, with their exact statements. This information is, of course, held in reserve, to be given only if requested.

In accident cases, retrodisplacement of the uterus is sometimes attributed to a fall or other minor injury. As a matter of fact, the uterus is so arranged and protected in the pelvis that a pathologic retrodisplacement by a minor accident is practically impossible. This subject is further discussed under Etiology of Uterine Retrodisplacement, in Chapter VI.

7. It would seem that consent to operation and to such details of operation as the surgeon may find best on examination or in the course of the operation, is implied when the patient accepts the surgeon's advice and goes through the preparation for operation. The jury, however, does not always take that view of the matter. Consequently, it is well to remove all chance of controversy on this point by having the patient sign a request for the operation and having the signature attested by a responsible witness, such as the nurse or an assistant physician. The following, with place and date, is a satisfactory form:

> I herewith request the performance of the required operation and such additional work as may be found necessary or advisable at the time.
>
> Witness_____   _____
>   (Signature of Patient)

When the husband appears querulous as to what is to be done or not done, it is a good plan to have him sign the request below the wife's signature. If the patient is a girl under age, her signature should be accompanied by that of one of the parents.

If the patient wishes to make any exception to the latitude of action, such exception should be noted in the request. This enables the operator and patient to understand each other clearly. For example, in a certain case of the senior author's requiring hysterectomy, the patient decided after full consideration that she wished both ovaries preserved even though one should be found diseased. The decision seemed to be against the patient's best interests, still it was her right to insist on it if she desired to do so. The exception to the latitude of action was noted in the signed request, and at the operation both ovaries were preserved.

8. The importance of the subject of foreign bodies left in the abdomen is often not appreciated by the physician until he is involved in a lawsuit concerning it. To make sure that no sponge or other foreign body is left in the peritoneal cavity at operation is a hard problem. This important subject in its various aspects is considered in detail by the senior author in a monograph, *Foreign Bodies Left in the Abdomen.*